FINAL
REMEDIAL INVESTIGATION REPORT

FOR THE
GULFCO MARINE MAINTENANCE
SUPERFUND SITE
FREEPORT, TEXAS

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LIST OF ACRONYMS

1,1,1-TCA	1,1,1-trichloroethane
1,1-DCE	1,1-dichloroethene
1,2,3-TCP	1,2,3-trichloropropane
1,2-DCA	1,2-dichloroethane
4,4’-DDD	4,4’-dichlorodiphenyldichloroethane
4,4’-DDT	4,4’-dichlorodiphenyltrichloroethane
AST	Aboveground Storage Tank
ATSDR	Agency for Toxic Substances and Disease Registry
ARAR	Applicable or Relevant and Appropriate Requirements
BERA	Baseline Ecological Risk Assessment
BHHRA	Baseline Human Health Risk Assessment
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
BaP	Benzo(a)pyrene
BCMCD	Brazos County Mosquito Control Department
cm/sec	centimeter per second
COI	Chemical of Interest
COPEC	Chemicals of Potential Ecological Concern
CAH	Chlorinated Aliphatic Hydrocarbons
Cl^-	Chlorine Ion
cis-1,2-DCE	cis-1,2-dichloroethene
CFWD	City of Freeport Water Department
CIP	Community Involvement Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CSM	Conceptual Site Model
CPT	Cone Penetrometer Testing
DNAPL	Dense Non-Aqueous Phase Liquid
DPT	Direct Push Technology
DO	Dissolved Oxygen
ECM	ECM & Associates
ERA	Ecological Risk Assessment
ET	Eco-Terra Technologies Group, LLC
EM	Electromagnetic
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
ESI	Expanded Site Inspection
FEMA	Federal Emergency Management Agency
ft/ft	feet per foot
ft/year	Feet per year
Fe(III)	Ferric Iron

LIST OF ACRONYMS

Fe(II)	Ferrous Iron
FSP	Field Sampling Plan
gpm	Gallons per minute
GIWW	Gulf Intracoastal Waterway
GRG	Gulfco Restoration Group
HQ	Hazard Quotients
HRS	Hazard Ranking System
IRIS	Integrated Risk Information System
IDW	Investigation-Derived Waste
LDL	LDL Coastal Limited LP
LNAPL	Light Non-Aqueous Phase Liquid
LTE	LT Environmental, Inc.
MSL	Mean Seal Level
MIP	Membrane Interface Probe
µmhos/cm	Micromhos per centimeter
mV	Millivolts
mg/L	Milligrams per Liter
NOAA	National Oceanic and Atmospheric Association
NPL	National Priorities List
NEDR	Nature and Extent Data Report
NAPL	Non-Aqueous Phase Liquid
Ohms/m	Ohms per meter
OVM	Organic Vapor Monitor
ORP	Oxidation/Reduction Potential
PBW	Pastor, Behling & Wheeler, LLC
PCB	Polychlorinated Biphenyls
PAH	Polynuclear Aromatic Hydrocarbons
PCOC	Potential Chemicals of Concern
PSA	Potential Source Area
PSV	Preliminary Screening Value
PSCR	Preliminary Site Characterization Report
PCL	Protective Concentration Level
PHA	Public Health Assessment
QA/QC	Quality Assurance and Quality Control
QAPP	Quality Assurance Project Plan
RD	Radiodetection
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SOW	Statement of Work
SSI	Screening Site Inspection
SLERA	Screening-Level Ecological Risk Assessment

LIST OF ACRONYMS

SVOC	Semi-volatile Organic Compound
SP	Spontaneous Potential
SBWD	Surfside Beach Water Department
PCE	Tetrachloroethene
TCEQ	Texas Commission on Environmental Quality
TDH	Texas Department of Health
TxDOT	Texas Department of Transportation
TDSHS	Texas Department State Health Services
TNRCC	Texas Natural Resource Conservation Commission
TWC	Texas Water Commission
TWDB	Texas Water Development Board
TCRA	Time Critical Removal Action
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TCLP	Toxicity Characteristic Leaching Procedure
TCE	Trichloroethene
UAO	Unilateral Administrative Order
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
VC	Vinyl Chloride
VOC	Volatile Organic Compound
WP-SAP	Work Plan & Sampling and Analysis Plan

EXECUTIVE SUMMARY

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. in Freeport, Brazoria County, Texas (the Site) to the National Priorities List (NPL) in May 2003. The EPA issued a modified Unilateral Administrative Order (UAO), effective July 29, 2005, which was subsequently amended effective January 31, 2008. The UAO required Respondents to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. As outlined in the UAO, the Remedial Investigation (RI) consists of collecting data to characterize site conditions, determining the nature and extent of the contamination at or from the Site, assessing the risk to human health and the environment and conducting treatability testing as necessary to evaluate the potential performance and cost of the treatment technologies that are being considered. The purpose of the RI Report is: (1) to provide a summary of the results of the field activities; (2) to characterize the Site; (3) to classify groundwater beneath the Site; (4) define the nature and extent of contamination; and (4) provide appropriate site-specific discussions regarding the fate and transport of Site contaminants.

The nature and extent of chemicals of interest (COIs) in Site environmental media was investigated in the RI through the installation and/or collection of 17 Site Intracoastal Waterway sediment samples, nine background Intracoastal Waterway sediment samples, four Site Intracoastal Waterway surface water samples, four background Intracoastal Waterway surface water samples, 33 Site fish tissue samples, 36 background fish tissue samples, 190 South Area soil samples, 10 background soil samples, 41 off-site soil samples, four former surface impoundment cap soil borings, 29 North Area soil samples, 56 wetland sediment samples, six wetland surface water samples, eight pond sediment samples, six pond surface water samples, 30 monitoring wells, eight temporary piezometers, five permanent piezometers, and three soil borings. The sampling and analytical program rationale and methods were described in the RI/FS Work Plan, the Field Sampling Plan (FSP), and Quality Assurance Project Plan (QAPP). Additional sampling and analyses were performed as part of a Baseline Ecological Risk Assessment (BERA) to address additional data needs indentified in the Screening-Level Ecological Risk Assessment (SLERA). The rationale and details for that program were described in the BERA Work Plan & Sampling and Analysis Plan (WP-SAP).

The RI conclusions are summarized by area/media below. The extent of COIs in these media were determined through comparisons to extent evaluation comparison values identified in the RI/FS Work Plan.

- Intracoastal Waterway Sediments – Certain polynuclear aromatic hydrocarbons (PAHs) (including some carcinogenic PAHs) and 4,4'-dichlorodiphenyltrichloroethane (DDT) were the only COIs detected in Site Intracoastal Waterway sediment samples at concentrations exceeding extent evaluation comparison values. These exceedances were limited to sample locations within or on the perimeter of the barge slip areas. Based on these data, the lateral extent of contamination in Intracoastal Waterway sediments, as defined by COI concentrations above extent evaluation comparison values, was identified as limited to small localized areas within the two Site barge slips. A vertical extent evaluation does not apply to this medium.

- Intracoastal Waterway Surface Water – No COIs were detected at concentrations above their respective extent evaluation comparison values in Site Intracoastal Waterway surface water samples.

- South Area Soils – COIs detected in South Area soils at concentrations exceeding extent evaluation comparison values included certain metals, polychlorinated biphenyls (PCBs) and PAHs (including some carcinogenic PAHs). The lateral extent of contamination in South Area soils, as defined by COI concentrations above their respective extent evaluation comparison values, was identified as limited to the South Area and potentially a small localized area immediately west and adjacent to the Site on off-site Lot 20. The vertical extent of COI concentrations above comparison values in South Area soils was defined by samples from depths less than 4 feet, except for a sample collected from a depth of 4.5 feet during a removal action performed at a tank farm in the South Area.

- North Area Soils – The only COIs detected in at least one North Area soil sample at concentrations exceeding their respective extent evaluation comparison values were arsenic, iron, lead, 1,2,3-trichloropropane (1,2,3-TCP), trichloroethene (TCE), benzo(a)pyrene (BaP), dibenz(a,h)anthracene, and PCBs. The lateral extent of contamination in North Area soils, as defined by COI concentrations above their respective extent evaluation comparison values, was limited to small localized areas within the North Area where upland soils are present (i.e., within the area surrounded by wetlands). The vertical extent of COIs at concentrations above extent evaluation comparison values in North Area soils extends to the saturated zone at some locations. Within the extent of North Area soil contamination, a small localized area of buried debris (rope, wood fragments, plastic, packing material, etc.) was encountered at depths of three feet bgs or more in the subsurface south of the former surface impoundments.

- Wetland Sediments – COIs detected in at least one wetland sediment sample at concentrations exceeding their respective extent evaluation comparison values included certain metals, pesticides and PAHs (including some carcinogenic PAHs). The lateral extent of contamination in wetland sediments, as defined by COIs concentrations above extent evaluation comparison values, was limited to specific areas within the Site boundaries and small localized areas immediately north and east of the Site. The vertical extent of COIs at concentrations above extent evaluation comparison values in wetland sediments was limited to the upper one foot of unsaturated sediment.

- Wetland Surface Water – Acrolein, copper, mercury, and manganese were the only COIs detected in at least one wetland surface water sample at concentrations exceeding their respective extent evaluation comparison values. The lateral extent of contamination in wetland surface water, as defined by COI concentrations above extent evaluation comparison values, was limited to localized areas within and immediately north of the Site. A vertical extent evaluation does not apply to this medium.

- Ponds Sediment – Zinc and 4,4'-DDT were the only COIs detected in at least one pond sediment sample at concentrations exceeding their respective extent evaluation comparison values. These exceedances were all limited to the Small Pond at the Site, which effectively defined the extent of contamination in pond sediments. A vertical extent evaluation does not apply to this medium.

- Ponds Surface Water – Arsenic, manganese, silver and thallium were the only COIs detected in at least one pond surface water sample at concentrations exceeding their respective extent evaluation comparison values. The lateral extent of pond surface water contamination, as identified by these exceedances of the extent evaluation comparison values, is defined by the boundaries of the two ponds. A vertical extent evaluation does not apply to this medium.

- Groundwater – The uppermost water-bearing unit at the Site, Zone A, is generally encountered at an average depth of approximately 10 feet below ground surface (bgs) and has an average thickness of approximately 8 feet. Saturated conditions were typically encountered at depths of 5 to 15 feet bgs. Although semivolatile organic compounds (SVOCs) and metals were detected in Zone A groundwater samples at concentrations exceeding extent evaluation comparison values, volatile organic compounds (VOCs), particularly chlorinated solvents, their degradation products, and benzene, were the predominant COIs detected in Zone A groundwater samples. The highest COI concentrations in Zone A groundwater were generally observed in wells ND3MW02 and ND3MW29, where visible Non-Aqueous Phase Liquid (NAPL) was observed in soil cores from the base of Zone A. Concentrations of several COIs, most notably 1,1,1-trichloroethane (1,1,1-TCA), tetrachloroethene (PCE), and TCE exceeded 1% of the compound's solubility limit, which is often used as an indicator for the possible presence of NAPL. Thus the groundwater data from these wells are consistent with the observation of visible NAPL within the soil matrix. The extent of VOCs exceeding extent evaluation comparison values and Dense Non-Aqueous Phase Liquid (DNAPL) was generally limited to a localized area within the North Area, roughly over the southern half of the former surface impoundments area, and a similarly-sized area immediately to the south of the former surface impoundments. The next underlying water-bearing unit, Zone B, is generally encountered at an average depth of approximately 19 feet bgs and has an average thickness of approximately 11 feet. The lateral extent of contamination in this zone was limited to VOCs detected in samples from a single well located south of the former surface impoundments. Concentrations of several COIs, most notably 1,1,1-TCA, PCE, and TCE, in NE3MW30B exceeded 1% of the compound solubility limit. These concentrations are consistent with the observation of visible NAPL within the soil matrix at the base of Zone B in the soil core from the boring at this location. The vertical extent of contamination in groundwater is limited to Zones A and B. Groundwater in these units is characterized by total dissolved solids (TDS) concentrations of approximately 30,000 mg/L or more. These TDS concentrations are approximately triple the 10,000 mg/L level used by EPA to define water as non-potable and by TCEQ to identify Class 3 groundwater (groundwater not considered useable as drinking water). Due to naturally high salinity, Zones A and B, as well as underlying groundwater-bearing zones within the upper approximately 200 feet of the subsurface have not been used as a water supply source.

- Fish Tissue - In order to evaluate potential risks from ingesting recreationally caught fish from the Intracoastal Waterway, fish tissue samples were collected from four Site zones and one background area within the Intracoastal Waterway. Samples of red drum, spotted seatrout, southern flounder, and blue crab were analyzed for COIs selected based on Intracoastal Waterway sediment data. Hazard indices calculated based on the fish tissue data were several orders of magnitude below one, indicating that the fish ingestion pathway does not present an unacceptable noncarcinogenic health risk. Cancer risk estimates based on these data were 2 x 10^{-6} or less and thus within or below EPA's target risk range, indicating that adverse carcinogenic health effects are unlikely. Based on that evaluation, it was concluded that exposure to site-related COIs via the fish ingestion pathway does not pose a health threat to recreational anglers fishing at the Site, or their families.

The potential occurrence and significance of biodegradation processes affecting the fate and transport of primary COIs in Site groundwater was assessed through evaluations of: (1) whether the overall contaminant plume is stable or shrinking; (2) whether degradation of the primary contaminants, as evidenced by the presence of biodegradation daughter products, is occurring; and (3) whether geochemical conditions that are favorable for such biodegradation processes are present. The stability of dissolved phase plumes for the primary groundwater COIs in Zone A was evaluated through examination of concentration data for those ten primary COIs for three groundwater sampling periods between July 2006 and June 2008. Time-series plots of these data show that the primary groundwater COI plume areas exhibit generally stable or declining trends. Sections of the projected southern boundaries of the plume areas for 1,1,1-TCA, cis-1,2-dichloroethene (cis-1,2-DCE), PCE, and TCE show some limited expansion between the three sampling events. This indication is primarily due to concentration increases of those COIs in samples from well ND3MW02. Similar increasing concentrations of 1,1,1-TCA, cis-1,2-DCE, PCE, and TCE were also observed in groundwater samples from ND3MW29, located at the southwestern corner of the former surface impoundments. Visible indications of NAPL were observed in the soil cores from the borings for wells ND3MW02 and ND3MW29 at depths within the screened intervals of those two wells. The dissolution of residual NAPL containing 1,1,1-

TCA, PCE and TCE within the local screened areas of ND3MW02 and ND3MW29 is a likely explanation for why concentrations of those COIs (and the degradation product cis-1,2-DCE) in samples collected from those wells were not observed to decrease over time as was observed in most of the other monitoring wells in the vicinity. Thus, despite a few exceptions for some COIs in the local areas around ND2MW29 and ND3MW02 in the plume interior where NAPL was observed in the soil core, the overall time-series plume area plots for the primary groundwater COIs clearly exhibit generally stable or declining trends.

Evidence of COI degradation is provided by the presence of likely biodegradation daughter products, most notably cis-1,2-DCE, and through consideration of molar ratios between chlorinated ethene parent and daughter products. Geochemical parameters were measured in Zone A groundwater samples at concentrations consistent with conditions conducive to reductive dechlorination, thereby providing supporting evidence for biodegradation. In particular, the key parameters of dissolved oxygen (DO), oxidation/reduction potential (ORP), ferrous iron (Fe(II)), and sulfide indicated favorable anaerobic conditions in nearly all samples evaluated. As further evidence, benzene, toluene, ethylbenzene and xylene (BTEX) or total organic carbon (TOC) concentrations in nearly half of the samples suggested a sufficient level of organic carbon for reductive dechlorination within Zone A and nearly half of the samples contained ethene/ethane at levels demonstrating reductive dechlorination of vinyl chloride (VC), the final step in the chlorinated ethene degradation process.

Biodegradation represents one of several processes affecting the extent and rate of contaminant migration in groundwater. The net overall effect of these various processes within the context of overall groundwater flow rates and directions was assessed by considering the extent of observed contaminant migration relative to the timeframe over which that migration may have occurred. The former surface impoundments are the source of COIs in Site groundwater. Chemicals introduced into the former surface impoundments with barge wash waters and associated sludges have had the potential to migrate in Site groundwater for at least 27 years (1982 to 2009) and potentially for 38 years (1971 to 2009), based on the operational period and closure data of the impoundments.

The lateral extents of the primary COIs in Zone A groundwater are generally limited to an area of approximately 200 ft or less (and in many cases, much less) from the boundary of the former surface impoundments. Dividing this distance by the potential migration period estimates of 27 to 38 years would correspond to contaminant migration rates ranging from approximately 5 ft/year to 7 ft/year. These rates are consistent with estimated Zone A average linear groundwater velocities of up to 5 feet/year. However, considering that these migration rates correspond to the furthest extent of potentially observed migration and that NAPL, a potential source of dissolved COIs, was observed in soil cores for monitoring wells located approximately 120 ft to 160 ft south of the impoundments, the limited extent of COIs observed in Zone A groundwater is consistent with both the low estimated groundwater velocity and further reductions in contaminant migration due to biodegradation. The observed dissolved COI plume stability, low groundwater velocity, and demonstrated contaminant degradation also predict limited potential for future migration.

The Baseline Human Health Risk Assessment (BHHRA) used data collected during the RI to evaluate the completeness and potential significance of potential human health exposure pathways indentified in Conceptual Site Models (CSMs) for the South and North Areas of the Site. Potential cancer risks to future indoor industrial workers in the North Area were estimated using maximum Zone A groundwater concentrations and the Johnson & Ettinger Vapor Intrusion Model. If a building were constructed over the affected groundwater plume in the future and vapor intrusion to indoor air were to occur, the hypothetical risks for this pathway were predicted to be greater than 1×10^{-4} while the noncarcinogenic hazard indices (HIs) were estimated to be greater than 1. This scenario was evaluated despite current restrictive covenants on Lots 55, 56, and 57 that require future building design to preclude indoor vapor intrusion, which would effectively make this pathway incomplete and, as such, eliminate adverse risks. Estimated risks from Zone A groundwater at the South Area were below EPA's goals and, therefore, adverse risks associated with the vapor intrusion pathway are unlikely in this area. It is important to note that restrictive covenants are also in place for all parcels of land associated with the Site that restrict future land use to commercial/industrial purposes and preclude the use of underlying groundwater for drinking water or as a potable source, irrigation or agricultural purposes. Based on this information, the BHHRA concluded that there were not unacceptable cancer risks or non-cancer HIs for any of the identified current or future exposure scenarios except for future exposure to an indoor industrial worker if a building were constructed over impacted groundwater in the North Area.

The Final SLERA used data collected during the RI to evaluate the completeness and potential significance of potential ecological exposure pathways indentified in CSMs for terrestrial and aquatic ecosystems at the Site. The SLERA concluded that it was necessary to proceed to a site-specific BERA because of exceedances of protective ecological benchmarks for direct contact toxicity to invertebrates in the sediment in the wetlands and Intracoastal Waterway, soil in the North Area, and surface water in the wetlands at the Site. No literature-based food chain hazard quotients (HQs) exceeded unity (1) in the SLERA and, as such, adverse risks to higher trophic level receptors were considered unlikely and were not evaluated further in the BERA.

In accordance with the SLERA conclusions, and per the study outlined in the BERA WP-SAP, data collected for the BERA included analytical chemistry analysis and toxicity testing of soil, sediment, and surface water samples corresponding to a gradient of COPEC concentrations. Based on these data, the BERA concluded that there was no statistically significant difference in the toxicity observed in samples collected at reference locations and the Site for sediment/soil exposure and that there was no toxicity associated with the surface water locations. Because of the lack of evidence of Site-related toxicity, development of ecologically-based remediation goals was not necessary. As such, no further ecological studies or ecologically-driven response actions are proposed. The Final BERA Report is currently under EPA review. The approved BERA will determine the actual ecological risks for the site, and any BERA findings that are not consistent with statements in this RI Report will be addressed as appropriate in the Feasibility Study.

1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. in Freeport, Brazoria County, Texas (the Site) to the National Priorities List (NPL) in May 2003. The EPA issued a modified Unilateral Administrative Order (UAO), effective July 29, 2005, which was subsequently amended effective January 31, 2008. The UAO required Respondents to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. Pursuant to Paragraphs 17 through 28 of the Statement of Work (SOW) for the RI/FS, included as an Attachment to the UAO, an RI/FS Work Plan and a Sampling and Analysis Plan were prepared for the Site. These documents were approved with modifications by EPA on May 4, 2006 and were finalized on May 16, 2006. This Remedial Investigation (RI) Report has been prepared in accordance with Paragraphs 39 and 41 of the SOW and Section 5.9 of the approved RI/FS Work Plan (the Work Plan) (PBW, 2006a). The report was prepared by Pastor, Behling & Wheeler, LLC (PBW), on behalf of LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy) and The Dow Chemical Company (Dow), collectively known as the Gulfco Restoration Group (GRG), and Parker Drilling Offshore Corporation, which has reached an agreement to participate in the work being performed at the Site. Figure 1 provides a map of the Site vicinity, while Figure 2 provides a Site map.

1.1 REPORT PURPOSE

As outlined in the UAO (Page 14, Paragraph 43), the RI consists of “collecting data to characterize site conditions, determining the nature and extent of the contamination at or from the Site, assessing risk to human health and the environment and conducting treatability testing as necessary to evaluate the potential performance and cost of the treatment technologies that are being considered.” The purpose of the RI Report, as specified in the Work Plan (Section 5.9) and the SOW (Page 24, Paragraph 41), is to provide “a summary of the results of the field activities to characterize the Site, classification of ground water beneath the Site, nature and extent of contamination, and appropriate site-specific discussions for fate and transport of contaminants.” Based on these objectives and consistent with the suggested RI report format in EPA RI/FS guidance (EPA, 1988b), this report contains a description of RI data collection and analysis activities and summaries of the Final Baseline Human Health Risk Assessment (BHHRA) (PBW, 2010a), the Final Screening-Level Ecological Risk Assessment (SLERA) (PBW, 2010b), and the Final Baseline Ecological Risk Assessment (BERA) (URS, 2011). It should be noted that the

Final BERA Report is currently under EPA review. The approved BERA will determine the actual ecological risks for the site, and any BERA findings that are not consistent with statements in this RI Report will be addressed as appropriate in the Feasibility Study. The RI Report, along with the Final BHHRA and BERA, is intended to provide necessary information for the development and screening of remedial alternatives, and refining the identification of applicable or relevant and appropriate requirements (ARARs) in subsequent FS-related tasks.

The nature and extent of contamination at and from the Site was previously described in the Final Nature and Extent Data Report (PBW, 2009), which was approved by EPA on April 29, 2009. The nature and extent of contamination evaluation previously discussed in the Final Nature and Extent Data Report (NEDR) has been repeated in this RI Report in order to provide a single document describing remedial investigation activities and results, and to provide a ready reference for contaminant fate and transport and risk assessment discussions in subsequent RI report sections. No treatability studies were proposed as part of the RI, so no treatability study discussions are included herein.

In accordance with the SLERA conclusions, a BERA Work Plan & Sampling and Analysis Plan (WP-SAP) (URS, 2010a) was submitted to and approved by EPA. As described therein, the BERA included chemical analyses and toxicity testing of soil, sediment, and surface water samples corresponding to a gradient of chemicals of potential ecological concern (COPEC) concentrations based on the RI data for these media. The BERA data were presented in the Preliminary Site Characterization Report (PSCR) (URS, 2010c) and are discussed in detail in the Final BERA Report. A summary of the BERA data is provided in Section 7.0 of this RI Report.

Two non-RI activities have been performed at the Site concurrent with the RI activities described herein. First, a Time Critical Removal Action (TCRA) was recently performed to remove residual material in the aboveground storage tanks (ASTs) at the AST Tank Farm on the Site. The TCRA activities were documented in a Final Removal Action Report (PBW, 2011), dated March 23, 2011, which included modifications requested in EPA’s March 9, 2011 letter approving a draft version of that Removal Action Report. As such, those activities are not described further herein.

Second, a supplemental wetland sediment sampling program was performed in June 2010 outside of the RI. This program, which was performed to support a possible Engineering Evaluation/Cost

Analysis (EE/CA), was proposed to EPA in a June 18, 2010 letter and was approved by EPA on that date. Preliminary results of the program were provided to EPA on July 16, 2010 and validated data were transmitted on August 11, 2010. Since the supplemental wetland sediment sampling program was performed outside of the RI, discussion of the sampling methods and results are not repeated in this RI report.

1.2 SITE BACKGROUND

1.2.1 Site Description

The Site is located in Freeport, Texas at 906 Marlin Avenue (also referred to as County Road 756) (Figure 1). The Site consists of approximately 40 acres along the north bank of the Intracoastal Waterway between Oyster Creek (approximately one mile to the east) and the Texas Highway 332 bridge (approximately one mile to the west). The Site includes approximately 1,200 linear feet (ft.) of shoreline on the Gulf Intracoastal Waterway. The GIWW is the third busiest shipping canal in the US (TxDOT, 2001) and on the Texas Coast extends 423 miles from Port Isabel to West Orange.

Marlin Avenue divides the Site into two primary areas (Figure 2). For the purposes of descriptions in this report, Marlin Avenue is approximated to run due west to east. The property to the north of Marlin Avenue (the North Area) consists of undeveloped land and the closed surface impoundments, while the property south of Marlin Avenue (the South Area) was developed for industrial uses with multiple structures, a dry dock, sand blasting areas, an AST tank farm, and two barge slips connected to the Intracoastal Waterway. The South Area is zoned as “W-3, Waterfront Heavy” by the City of Freeport. This designation provides for commercial and industrial land use, primarily port, harbor, or marine-related activities. The North Area is zoned as “M-2, Heavy Manufacturing.” Restrictive covenants prohibiting any land use other than commercial/industrial and prohibiting groundwater use have been filed for all parcels within both the North and South Areas. Additional restrictions requiring any building design to preclude indoor vapor intrusion have been filed for Lots 55, 56 and 57 (see Figure 2 for lot designations and boundaries). A further restriction requiring EPA and Texas Commission on Environmental Quality (TCEQ) notification prior to any building construction has also been filed for Lots 55, 56 and 57.

Adjacent property to the north, west, and east of the North Area is unused and undeveloped. Adjacent property to the east of the South Area is currently used for industrial purposes. The property to the west of the South Area is currently vacant and previously served as a commercial marina. The Intracoastal Waterway bounds the Site to the south. Residential areas are located south of Marlin Avenue, approximately 300 feet west of the Site, and 1,000 feet east of the Site.

The South Area includes approximately 20 acres of upland that was created from dredged material from the Intracoastal Waterway. Some of the North Area is upland created from dredge spoil, but most of this area is considered wetlands, as per the United States Fish and Wildlife Service (USFWS) Wetlands Inventory Map (Figure 3).

The Intracoastal Waterway is a major corridor for commercial barge traffic and other boating activities. Approximately 50,000 commercial vessel trips and 28 million short tons of cargo were transported on the Galveston-to-Corpus Christi section of the Intracoastal Waterway in 2006. The vast majority of this cargo (greater than 23 million tons) was petroleum, chemicals or related products (USACE, 2006). The Intracoastal Waterway design width and depth in the vicinity of the Site, based on United States Army Corps of Engineers (USACE) mean low tide datum, is 125 feet wide and 12 feet deep (USACE, 2008).

1.2.2 Site History

A detailed understanding of the Site's operating history was developed through a review of historical aerial photographs (1944, 1965, 1974, 1977, 1985, 1987, 1995, 2000, and 2004), personnel interviews, operating information from air permit applications, investigation report summaries, and regulatory agency correspondence, inspection reports and memoranda/communication records. Mr. Billy Losack of LDL was an invaluable resource in this effort. Mr. Losack initially worked at the Site during the 1960s and later directed the dismantling and removal of many Site structures, operational equipment and appurtenances during 1999 and 2000 after LDL acquired the Site. Mr. Losack's personal familiarity with the Site was augmented by his multiple discussions during the structure/equipment dismantling work with personnel directly involved in the day-to-day operations of Site facilities. PBW reviewed historical aerial photographs and site maps/process diagrams from air permit applications with Mr. Losack to identify various Site features during its operational history.

Key activities during the operational history of the Site are summarized in Table 1. Historical aerial photographs documenting Site operations are provided in Appendix A. For the purposes of the discussion below, the operational history has been divided into the following periods:

- Pre-barge cleaning operations (prior to 1971);
- Gulfco Marine Maintenance, Inc. (Gulfco) Operations (1971 – 1979);
- Fish Engineering and Construction, Inc. (Fish) Operations (1979 – 1989);
- Hercules Offshore Corporation and later Hercules Marine Services (collectively referred to as Hercules) Operations (1989 – 1999); and
- LDL Ownership (1999 to present).

The majority of the Site, including Lots 21 through 25, and Lots 55, 57, and 58 (see Figure 2 for approximate lot boundaries) are currently owned by LDL. Lot 56 was not sold to Hercules by Fish in 1989, but was deeded to Jack Palmer and Ron Hudson in 1997.

<u>Pre-barge Cleaning Operations</u>

The earliest historical photograph of the Site vicinity that could be obtained by PBW was for 1944 (Appendix A). This photograph shows the Intracoastal Waterway south of the Site with what appears to be a sloping and somewhat eroded shoreline north of the waterway. Marlin Avenue is not present in this photograph; however, a significant linear feature is apparent in the northern part of the Site. This feature may have been a berm or ditch associated with dredge spoiling activities in the area to the south. The light-colored area south of the berm/ditch system may correspond to dredged material being free spoiled south of the berm. Spoil from the Intracoastal Waterway can be seen in the southern part of the Site. Deed records for specific lots on the Site (Brazoria County, 1937, 1939, and 1945) conveyed an easement to United States of America for the work of “constructing, improving, and maintaining an Intracoastal Waterway”, and for “the deposit of dredged material.”

The berm/ditch feature and Marlin Avenue are visible in the 1965 photograph of the Site area. The previously sloping north shore of the Intracoastal Waterway appears as a distinct upland area and a canal and future boat slip/marina area is present on the adjacent property to the west of the Site. According to Mr. Billy Losack (Losack, 2005), off-shore oil platform fabrication work was performed in the northeast part of the South Area during the early 1960s. Raw materials and supplies were brought onto the Site, the platform fabrication work (welding, metals cutting, etc.) was performed, and the finished products and any unused materials/supplies were removed from the Site. As supported by the 1965 photograph, no permanent structures were associated with those operations.

Gulfco Marine Maintenance, Inc. Operations

As noted in Table 1, Gulfco operated a barge cleaning facility on the Site from 1971 to 1979. According to the Hazard Ranking System (HRS) Documentation Record prepared for the Site by the Texas Natural Resource Conservation Commission (TNRCC) (TNRCC, 2002), barges brought to the facility were cleaned of waste oils, caustics, and organic chemicals, and the wash waters were reportedly stored in three surface impoundments in the North Area. The impoundments were described as earthen lagoons with a natural clay liner (TNRCC, 2000a) and were reportedly 3 feet deep (Guevara, 1989). Discharges from the impoundments in July 1974 and August 1979 reportedly "contaminated surface water outside of ponds" and "damaged some flora north of the ponds" (EPA, 1980).

The former surface impoundments are visible in a 1974 aerial photograph (Appendix A). A projected buried debris area appears visible south of the impoundments on this photograph. As described later in Section 4.5.1 of this RI report, various materials, including rope, wood fragments, plastic, packaging material, etc. were encountered in at depths of three feet or more bgs in soil borings drilled in this area during RI field activities.

Other Site features at the time of Gulfco's operations at the Site are noted on a 1977 aerial photograph (Appendix A). This photograph shows two barge slips along the Intracoastal Waterway, including a barge within Barge Slip 2, and two other barges staged on the shoreline near the Site. A dry dock area used for barge repair, the Site office, shop and lunch room areas are present in the South Area. A fresh water tank (identified based on Losack, 2005) and several other storage tanks are visible adjacent to Barge Slip 2 in the photograph. The three surface impoundments are present in the North Area. The path of a pipeline from the tank area to the impoundments is projected on the 1977 photograph. The northern end of this pipeline was located and the projected path was generally confirmed by the ground surface geophysics evaluation (see Section 2.2) during the RI.

Several noteworthy features on adjacent or nearby properties are also apparent on the 1977 photograph. A commercial marina with covered boat slips and several other surface structures is visible on the property immediately west of the Site. Other undetermined industrial development is indicated on the property east of the Site, including a tank farm located approximately 500 feet east of the Site boundary.

Fish Engineering and Construction, Inc. Operations

Fish purchased the Site and barge cleaning operation from Gulfco on November 12, 1979. As described by the TNRCC (TNRCC, 2000a), Fish’s primary operations consisted of receiving chemical barges, draining the barges and removing the residual product heels. The barges were reportedly washed with hot water and/or detergent solution and air dried prior to any repair work (welding and sandblasting). It was reported that barge heels were stored in small tanks to be sold for reuse and recovery, and wash waters were stored in impoundments and eventually sent off-site for deep well injection. The impoundments were taken out of service on October 16, 1981 and wash waters were stored in tanks or floating barges thereafter (TNRCC, 2000a).

The surface impoundments were closed in accordance with a Texas Water Commission-approved plan, with closure certification provided on August 24, 1982 (Carden, 1982). Impoundment closure activities involved removal of liquids and most of the impoundment sludges prior to closure. The sludge that was difficult to excavate (approximately 100 cubic yards of material) was solidified with soil and left mainly in Impoundment 2 (the larger impoundment shown to the east in the 1977 photograph) (Guevara, 1989). The impoundments were capped with three-feet of clay and a hard-wearing surface.

Site features at the time of Fish’s operations at the Site are illustrated by aerial photographs from 1985 and 1987 (Appendix A). Both of these photographs show the former surface impoundments capped and closed. A large barge, presumably used for wash water storage is located in the eastern half of Barge Slip 2. The dry dock, office, shop, lunchroom/restroom and storage tank areas are visible in the South Area in these photographs. A Quonset hut (used for general storage according to Losack, 2005), electrical shed, and concrete laydown areas are also apparent south of Marlin Avenue. Tank designations and other details noted on these photographs (e.g., Water Heater) were determined from comparisons to Site maps and process flow diagrams information in Fish's air permit exemption application (Fish, 1982) and discussions with Billy Losack (2005). Three product storage tanks shown on the permit application maps immediately south of the former surface impoundments can be seen on both the 1985 and 1987 photographs. Six wash water tanks, also described in an air permit exemption application (Fish, 1982) are visible in the southeastern part of the Site in the 1987 photograph. The Fresh Water Pond and a second pond also north of Marlin Avenue are visible on both photographs. Other areas, such as the employee parking area north of Marlin Avenue, sand pot and air compressor locations, and the two septic tank areas south of Marlin Avenue are labeled on the 1985 photograph based on Losack, 2005. It appears that the septic tanks directly north of the former shop area were observed by TNRCC in 2000 (Photograph 4 in TNRCC, 2000b).

Off-site features are visible on the 1985 photograph, but due to poor photograph quality are not as clear in the 1987 photograph. The commercial marina is present on the adjacent property to the west; however, the boat slip cover structure is not present and several boats are visible within the marina. The industrial operations to the east of the Site in 1985 appear relatively unchanged from 1977.

<u>Hercules Operations</u>

Hercules Offshore Corporation purchased the Site (except for Lot 56) and barge cleaning operation from Fish on January 20, 1989. Subsequently, the Site was conveyed to the entity that became Hercules Marine Services Corporation. These entities are collectively referred to as Hercules. According to the TNRCC (TNRCC, 2000a), Hercules' operations included barge cleaning and repair. Product heels were removed from barges into ASTs and subsequently sold. Barges were washed with water and detergent. Wash waters were stored in storage tanks and then either transported to an off-site injection well or transported to Empak in Deer Park, Texas (TNRCC, 2000a). Mickey Tiner, a project manager for Hercules from February 1990 to September 1991, indicated in an interview with TNRCC personnel (TNRCC, 1997b) that Hercules discharged wastewater from barge cleaning operations directly into the Intracoastal Waterway at night while he was at the facility. To address concerns over fugitive dust emissions associated with sand blasting operations at the Site, Hercules erected a dust control screen on the western boundary of the South Area. Hercules filed for Chapter 7 bankruptcy on May 4, 1998.

Site features at the time of Hercules' operations at the Site are illustrated by an aerial photograph from 1995 (Appendix A). No barges are visible in this photograph; however, the dry dock, office, shop, Quonset hut, electrical shed, lunchroom/restrooms and concrete laydown areas visible in previous aerial photographs can be seen. The AST tank farm area appears to be surrounded by a containment wall in 1995. Two sand blasting operation areas south of Marlin Avenue are more clearly visible in 1995 than in previous photographs, but it is uncertain whether this is due to increased operations or the quality of the 1995 photograph. Only two of the six wash water tanks visible in the 1987 photograph are apparent in 1995. A pipeline running from the southern end of the former AST Tank Farm containment area to the Intracoastal Waterway has been plotted on the 1995 aerial photograph. Mr. Billy Losack (Losack, 2005) indicated that he removed this pipeline as part of Site structure/equipment dismantling activities performed after acquisition of the Site by LDL.

The commercial marina located immediately west of the Site appears to have ceased operations in the 1995 photograph. In contrast, the industrial operations to the east have expanded as indicated by a new boat slip/dock area and AST immediately adjacent to the Site.

LDL Ownership

LDL acquired the Site (except for Lot 56) from the bankruptcy court on August 2, 1999. Under LDL's direction, most Site equipment was removed from the Site during the initial four months of LDL's ownership (approximately August through November, 1999). In April 2002, LDL leased part of the Site to Eco-Terra Technologies Group, LLC (ET) who had obtained a Texas Railroad Commission permit to set-up a crude oil recycling operation. ET modified some of the tankage and piping in the former AST Tank Farm area to support this operation, but according to Losack, 2005, only about seven truckloads of crude oil were shipped to the Site. ET ceased operations and left the Site after approximately five months.

Site features at the approximate time that LDL acquired the Site are illustrated by an aerial photograph from 2000 (Appendix A). This photograph is very similar to the 1995 photograph with a key difference being the removal of all of the former wash water tanks from the southeastern corner of the Site. In contrast, a 2004 aerial photograph (Appendix A) shows a significant change, with all structures removed from the Site, except for the electrical shed and tanks in the former AST tank farm area.

Aerial spraying of the wetland areas north of Marlin Avenue, including the North Area, for mosquito control has historically been and continues to be performed by the Brazoria County Mosquito Control District and its predecessor agency, the Brazoria County Mosquito Control Department (both referred to hereafter as BCMCD). Aerial spraying for mosquito control has been performed over rural areas in the county since 1957 (Lake Jackson News, 1957). Historically, aerial spraying of a dichlorodiphenyltrichloroethane (DDT) solution in a "clinging light oil base" was performed from altitudes of 50 to 100 feet (Lake Jackson News, 1957). Recently BCMCD has been using Dibrom®, an organophosphorus insecticide, with a diesel fuel carrier through a fogging atomizer application (Facts, 2006, 2008a, 2008b) as well as other compounds such as Scourge™, Kontrol 30-30, and Fyfanon® (Miller, 2010). Truck-based spraying has also been performed along Marlin Avenue. Both types of spraying were observed during the RI.

1.2.3 Previous Investigations

Previous investigations at the Site included the following:

- **Surface Impoundment Groundwater Monitoring Wells (1982)** – In conjunction with closure of the former surface impoundments in 1982, Fish installed four monitoring wells on the perimeter of the impoundments. All four wells were screened from 38 to 48 feet below grade and were sampled at least four times from July 1982 through September 1982. The wells were reportedly plugged in December 1983 (TNRCC 2000a).

- **Surface Impoundment Groundwater Monitoring Wells (1989)** – In January 1989, Pilko & Associates installed three monitoring wells around the perimeter of the former surface impoundments. The approximate locations of these wells, designated as HMW-1, HMW-2, and HMW-3 are shown on Figure 4. The wells were completed from 8 to 18 feet below grade (Hercules, 1989a). These wells are still present at the Site.

- **Groundwater Monitoring Wells (the South Area)** – Three permanent monitoring wells (PVC well casing, outer steel protective casing) are present in the South Area (MW-1, MW-2 and MW-3 on Figure 4). The construction details and installation dates for these wells are not known, although the total depths are reported to range from 15.2 to 20.3 feet below grade (TNRCC, 2000a). The wells were sampled by LT Environmental, Inc. (LTE) in 1999 and the TNRCC in 2000 (see below). The wells are still present, although the surface completions of some of the wells appeared damaged.

- **ECM Phase I and II Investigations (1998 - 1999)** – According to LTE (1999), ECM & Associates (ECM) performed Phase I and II investigations at the Site that were summarized in a Phase II Sampling Report dated January 27, 1999. This report is not available and thus the scope and conclusions as reported in LTE, 1999 could not be confirmed. LTE (1999) noted several ECM investigation findings that served as a basis for subsequent site characterization work performed by LTE.

- **LTE Site Characterization (1999)** – In March 1999, LTE performed a series of investigation activities at the Site, including sampling of AST and drum contents, accumulated water within the former AST tank farm containment area, soils, residual sandblasting material, sediment from the Fresh Water Pond, and groundwater. Groundwater samples included samples from temporary monitoring wells installed by LTE and samples from previously existing wells MW-1, MW-2, and MW-3.

- **TNRCC Screening Site Inspection (2000)** – In cooperation with the EPA, TNRCC performed a Screening Site Inspection (SSI) at the Site in 2000 (TNRCC, 2000a). The SSI included collection of on-site and off-site soil samples, Intracoastal Waterway sediment samples (adjacent to and distant from the Site), pond sediment samples and groundwater samples from existing monitoring wells MW-1, MW-2 and MW-3.

- **TNRCC Expanded Site Inspection 2001** –In cooperation with EPA, TNRCC performed an Expanded Site Inspection (ESI) in January 2001. The ESI included collection of groundwater samples from temporary on-site and off-site monitoring wells. Although a separate ESI report was not prepared, the findings of the ESI were included in the HRS Documentation Record (TNRCC, 2002).

In addition to these investigation activities, a Public Health Assessment (PHA) of the Site was prepared by the Texas Department of Health (TDH) for the Agency for Toxic Substances and Disease Registry (ATSDR) (TDH, 2004). The PHA concluded that contaminants in soil, sediment and groundwater pose no apparent public health hazards, but the overall public health hazard could not be determined due to a lack of data for all pathways.

1.2.4 Potential Source Areas

Thirteen Potential Source Areas (PSAs) were identified at the Site based on the Site operations history and previous investigations as described above. These PSAs are shown on Figure 5. As described in the Work Plan, the Site investigation program, including number/types and sample analyses, was designed in consideration of the activities performed and chemicals used in each PSA.

1.3 REPORT ORGANIZATION

The organization for this RI report has been based on the suggested format provided in Table 3-13 of EPA's RI/FS Guidance (EPA, 1988b). As such, Section 2.0 describes Study Area investigation activities, Section 3.0 details the physical characteristics, including surface and subsurface features, Section 4.0 provides the nature and extent of contamination evaluation, Section 5.0 describes contaminant fate and transport, Section 6.0 summarizes the BHHRA, Section 7.0 summarizes the BERA, and Section 8.0 provides the report summary and conclusions. References cited in this report are listed in Section 9.0. As noted previously, the Final BERA Report is currently under EPA review. The approved BERA will determine the actual ecological risks for the site, and any BERA findings that are not consistent with statements in this RI Report will be addressed as appropriate in the Feasibility Study.

2.0 STUDY AREA INVESTIGATION

2.1 INTRODUCTION

Site investigation activities were performed using a phased approach for each environmental medium investigated. The first investigative phase for each medium involved the collection of environmental samples from that medium at locations specified in the Work Plan, or, in some cases, at initial locations jointly determined by GRG and EPA representatives. Following validation, data from an initial investigation phase were compared to Preliminary Screening Values (PSVs) specified in the Work Plan and background levels (as appropriate for that specific medium and COI) for the purpose of assessing whether the lateral and (for most media) vertical extent of COI in the environmental medium being evaluated had been identified. In cases where perimeter samples contained one or more COIs exceeding both their respective PSVs and background levels (where applicable), additional investigative phases were proposed in accordance with Work Plan provisions.

The scope of an additional investigative phase, and the PSV/background exceedances requiring additional investigation were typically proposed in a letter to EPA. Following discussion/resolution of EPA comments (if any) and subsequent EPA approval, the proposed work was performed. After the resultant data were validated and compared to PSVs/background, additional investigation phases were proposed if warranted. This process was repeated as necessary until no PSV/background exceedances associated with the Site were indicated in subsequent perimeter samples (horizontal and vertical, depending on medium). For some media, such as Intracoastal Waterway surface water, only a single investigative phase was required. For other media, such as groundwater, multiple investigative phases were performed. Correspondence related to the proposal and approval of various investigation phases is listed in Table 2.

Consistent with the suggested RI report format (Table 3-13 in EPA, 1988b), this section of the report outlines field activities performed as part of Site characterization. These activities are generally discussed by geographic area (e.g. Intracoastal Waterway, North Area, South Area) and by specific environmental media (e.g. soil, sediment, etc.) within those areas in the subsections below. Groundwater activities are discussed separately at the end of the section. Investigation data related to physical characteristics of the Site are discussed in Section 3.0. Investigation data pertinent to the nature and extent of contamination evaluation are discussed in Section 4.0.

All RI sample locations, except background samples, are shown on Plate 1. Sample collection methods, field measurements procedures, laboratory analytical methods and data validation procedures were specified in the Field Sampling Plan (FSP) (PBW, 2006b) and the Quality Assurance Project Plan (QAPP) (PBW, 2006c). Quality assurance and quality control (QA/QC) samples were collected at the frequency specified in the FSP. Detailed descriptions of field and laboratory procedures specified in the FSP and QAPP are not repeated herein; however, general discussions of these procedures are noted in the specific investigation summaries below. Additions or modifications to the FSP and QAPP procedures were typically proposed and approved as part of the GRG/EPA correspondence dialogue summarized in Table 2, or were discussed in the field among GRG and EPA representatives prior to implementation. Field activities were performed in accordance with the Site-specific Health and Safety Plan (PBW, 2005).

2.2 SURFACE GEOPHYSICS EVALUATION

In accordance with Section 5.6.2 of the Work Plan, a surface geophysical survey was performed to attempt to locate former pipelines at the Site that may have been used to transport product material or wash water associated with the barge cleaning process from the barges and former AST Tank Farm to the former surface impoundments or to former wash water storage tanks located to the east of the AST Tank Farm. As part of this survey, an electromagnetic (EM) metal detector and an EM radiodetection (RD) meter were used to evaluate subsurface magnetic anomalies caused by buried metal (i.e., higher EM measurements were indicative of anomalies potentially associated with buried metal).

The surface geophysical survey was performed on June 27 and 28, 2006. EM and RD data were collected along twenty-two transects (Figure 6). The EM data (contoured on Figure 6) suggested the presence of a pipeline between the AST Tank Farm area and the former surface impoundments in the North Area. The northern end of this pipeline was observed aboveground just south of the former surface impoundments. EM data anomalies interpreted as indicative of the pipeline location were not consistently observed north of Marlin Avenue. This information, along with observed corrosion of visible pipeline sections immediately south of the former surface impoundments suggests that the pipeline was appreciably deteriorated in some areas. In an attempt to confirm the specific pipeline location, the exposed northern pipeline section was induced with a radio frequency and the area where the pipeline was suspected to be present was subsequently scanned with an RD meter. The induced RD detections, which are shown as a series of individual RD detection points on Figure 6, provide an approximate projection of the pipeline location. Based on this information, the pipeline location previously projected based on historical aerial photographs was found to be reasonably accurate and the appropriateness of Site investigation sample locations proposed in the Work Plan and FSP near the projected pipeline location was confirmed.

The EM survey also indicated several EM data anomalies to the east of the AST Tank Farm (Figure 6). It is likely that these anomalies were caused by the presence of concrete slabs with metal plates (grounding strips for historical welding operations at the Site) on the slab surface. The data were not interpreted as suggesting the presence of any underground pipelines to the east of the AST Tank Farm.

2.3 INTRACOASTAL WATERWAY

2.3.1 <u>Sediments</u>

For the RI, Intracoastal Waterway sediments were investigated through the collection and analysis of nine samples from a background area and 17 samples adjacent to the Site. All samples were collected from the 0 to 0.5 foot depth interval as specified in the Work Plan and in the FSP. The background sample locations (IWSE21 through IWSE29) are shown on Figure 7 and the Site sample locations (IWSE01 through IWSE16, and IWSE34) are shown on Figure 8. In addition to the 17 sampled Site locations, multiple attempts were made to collect samples at two additional Site locations (IWSE35 and IWSE36) on Figure 8; however, sufficient sediment thickness for an adequate sample (as jointly determined by GRG and EPA representatives) was not present at these locations. Additional Intracoastal Waterway sediment samples were collected as part of the BERA in accordance with the BERA WP-SAP. These samples and their associated data are discussed in Section 7.0 of this report.

Intracoastal Waterway sediment samples were collected using an Ekman grab sampler with the sampler lowered to the bottom of the waterway on a cable or a stainless steel pole. Prior to removing sediments from the sampler upon retrieval, overlying water was drained by tilting the sampler and a sub-sample was collected from the top of the closed sampler using a pre-cleaned spoon. Sediment from the sampler was placed into a stainless steel bowl and a sub-sample immediately removed with a stainless steel spoon and placed into the sample container for volatile organic compound (VOC) analysis. The remainder of the sample was then homogenized and placed into containers for other analyses.

2.3.2 Surface Water

Intracoastal Waterway surface water was investigated through the collection and analysis of four samples from a background area and four samples adjacent to the Site. Intracoastal Waterway samples were composites consisting of three sub-samples (one sub-sample from approximately one foot below the water surface, a second sub-sample from the mid-depth of the water column, and a third sub-sample from approximately one foot above the base of the water column). The background sample locations (IWSW30 through IWSW33) are shown on Figure 7 and the Site sample locations (IWSW17 through IWSW20) are shown on Figure 8.

Water samples were collected using a peristaltic pump fitted with pre-cleaned sample tubing. At each station, the sample tubing and instrument probes (attached 1 foot above a weight) were slowly lowered until the weight touched the surface of the sediment. Prior to sampling, the water collection apparatus (pre-cleaned Teflon and C-flex tubing attached to a 5 micron (pre-filter) and a 0.45 micron final filter) was purged for two (2) minutes. Following the system purge, a filtered water sub-sample (1/3 total volume) was collected directly into a sample container. This process was repeated at the two remaining sample depths at each sample location to complete the composite filtered water sample (for dissolved metals analyses). The water filters were then removed from the sample tubing and an unfiltered water sub-sample (1/3 total volume) was collected at each sample depth to provide a composite unfiltered water sample (for all other analyses). Field measurements of pH, temperature, conductivity, salinity, dissolved oxygen (DO), oxidation/reduction potential (ORP), and turbidity were recorded during sampling. These field measurements are included in the analytical database provided in electronic form (on DVD) in Appendix B of this report.

2.3.3 Fish Tissue

Based on the analytical results for the Intracoastal Waterway sediment samples and in accordance with Section 5.6.8 of the Work Plan, fish tissue samples were collected from four Site zones (Figure 8) and one background area (Figure 7) within the Intracoastal Waterway. Samples of red drum (*Sciaenops ocellatus*) (6 samples), spotted seatrout (*Cynoscion nebulosus*) (9 samples), southern flounder (*Paralichthys lethostigma*) (9 samples), and blue crab (*Callinectes sapidus*) (9 samples) were collected from the Site for laboratory analysis. Samples of these species were also collected from the background area and were archived. As previously discussed with EPA on December 14, 2006 and documented in the December 2006 monthly status report, only six red drum samples were collected from the Site over the sampling period due to difficulty in collecting legal size fish.

Finfish specimens were collected using a combination of gill nets and baited hooks. Three different gill net mesh sizes were used. Gill nets were either 150 feet or 50 feet long, and six feet deep. Collected finfish were inspected for injuries, disease and other anomalies. A few physical injuries were noted that were most likely caused by being captured in gill nets. No ulcers, lesions, fin erosion, external deformities or gill discoloration that could be the result of disease or exposure to toxic substances were observed. Edible tissue fillets were processed and placed in sample jars. Total weight, total length, fillet weight, sample weight, sample date, sample time, and sample station were recorded during tissue processing.

Adult blue crabs were collected in baited commercial type crab traps (i.e., vinyl covered wire mesh) baited with menhaden and Spanish sardines. Edible tissue from 3 legal sized crabs was composited for each blue crab sample. Legal sized crabs were inspected for injuries, disease and other anomalies. Physical injuries such as missing periopods (walking legs), chelipeds (claws), or broken spines were observed on several organisms. No ulcers, lesions, external deformities, or discoloration that could be the result of disease or exposure to toxic substances were observed. Total weight, width, sample weight, sample date, sample time, sex, and sample station were recorded during crab sample processing/compositing.

2.4 SOUTH AREA

In addition to groundwater investigations described on a Site-wide basis in Section 2.7 below, RI activities in the South Area consisted of two separate soil programs with differing scopes and objectives, as specified in the Work Plan. The first South Area soil sampling program involved the collection of soil samples from multiple depth intervals for evaluating the lateral and vertical extent of COIs in Site soils. This program is referred to as the “south area soil investigation”. The second soil program, which was limited to the collection of surface soil samples (0 to 1-inch depth interval) from the western part of the South Area and off-site properties immediately west of the South Area, had the focused objective of evaluating the potential for migration of metals associated with Site sandblasting operations to produce elevated concentrations of COIs in soils in residential areas to the west. Consistent with the terminology in the Work Plan, this program will be referred to as the “residential surface soil investigation” in this report. Descriptions of these two South Area soil investigation programs are provided below.

As noted previously, a TCRA was recently performed to remove residual material in the ASTs at the AST Tank Farm in the South Area of the Site. The TCRA activities were documented in a Final Removal Action Report (PBW, 2011), dated March 23, 2011, which included modifications requested in EPA’s March 9, 2011 letter approving a draft version of that Removal Action Report. The Final Removal Action Report included a description of conditions relating to the removal action and associated sampling results. As such, those activities are not described further herein.

2.4.1 <u>South Area Soil Investigation Program</u>

The South Area soil investigation program consisted of two phases. In accordance with Section 5.6.3 of the Work Plan, Phase 1 soil samples were collected for chemical analysis from the 0 to 0.5 ft and 1 to 2 foot depth intervals from 85 locations in the South Area. Based on data from these initial Phase 1 samples (discussed below), Phase 2 soil samples were collected from the 4 to 5 foot depth interval from 15 of these locations from the South Area and from various depth intervals at seven locations on the adjacent former commercial marina parcel to the west (also referred to as “Lot 20”). The South Area soil investigation sample locations are shown on Figure 9.

Soil samples were collected using either: (1) plastic trowels, or (2) a split-spoon sampler driven by direct-push technology (DPT) techniques or a drill rig. Soil borings drilled with DPT were advanced using a hydraulic ram to drive a butyrate-lined, split-spoon sampler. Sub-samples for VOC analyses were collected for the soil core barrels using EnCore® samplers.

2.4.2 Residential Surface Soil Investigation Program

Soil samples were collected as part of a residential surface soil investigation program to evaluate the potential for migration of metals associated with Site sandblasting operations to produce elevated concentrations of those metals in soils in residential areas to the west. As specified in Section 5.6.3 of the Work Plan, this investigation included the collection of surface soil samples for chemical analysis from the 0 to 1 inch depth interval at 10 specified locations on Site Lot 21, and 27 specified locations on off-site Lots 19 and 20 (see Figure 10 for sample locations). These samples were collected using disposable plastic trowels.

2.5 NORTH AREA

As noted previously, most of the North Area consists of wetlands, with upland soils limited to the area between the former surface impoundments and Marlin Avenue. Two ponds are also present within this area. In addition to groundwater investigations described on a Site-wide basis in Section 2.7 below, RI activities in the North Area consisted of an evaluation of the former surface impoundments cap, and investigations of soils, wetland sediments, wetland surface water, pond sediments and pond surface water. Descriptions of each of these investigations are provided below. Additional North Area soil, sediment, and surface water samples were collected as part of the BERA. These samples and their associated data are discussed in Section 7.0 of this report.

2.5.1 Former Surface Impoundments Cap

In accordance with Section 5.6.1 of the Work Plan, Site investigation activities included an evaluation of the construction materials and thickness of the clay caps constructed on the former surface impoundments during closure of the impoundments in 1982. This evaluation involved drilling and sampling of four borings through the caps, geotechnical testing of representative cap material (clay) samples, and performance of a field inspection of the caps, including observation of desiccation cracks, erosion features, and overall surface condition. The locations of the cap geotechnical soil borings are shown on Figure 11. These borings were drilled using DPT methods with soil samples collected for visual inspection and logging using a butyrate-lined, split-spoon sampler. Shelby tube samples for geotechnical testing were collected from a separate, immediately adjacent boring with the interval for testing selected within the clay cap based on the observed lithology. Geotechnical boring logs are provided in Appendix C.

2.5.2 North Area Soil Investigation

In accordance with Section 5.6.3 of the Work Plan, North Area RI Phase 1 soil samples were collected for chemical analysis from the 0 to 0.5 ft and 1 to 2 foot depth intervals from 14 upland locations (Figure 11). Based on the Phase 1 soil data from the 1 to 2 foot depth interval samples at these locations, a Phase 2 soil sample was collected from the 4 to 5 foot depth interval at location ND3SB04. In addition to this Phase 2 sample, three shallow soil borings (SB-201, SB-202, and SB-203 on Figure 11) were advanced at locations where scrap metal was observed at the ground surface. Soil samples were collected for laboratory analysis from the 0 to 0.5 foot and 1.5 to 2.0 foot depth intervals from these three borings. Three additional Phase 2 borings (SB-204, SB-205, and SB-206) were advanced in the vicinity of Phase 1 soil boring NE3SB09 (see Figure 11), where subsurface debris (e.g., a section of rope) was observed in the auger cuttings from the boring for adjacent monitoring well NE3MW05 (see Figure 4), in order to evaluate the presence and/or composition of debris in this area. Soil samples for laboratory analyses were collected from multiple depth intervals from these three borings, generally corresponding to one foot depth intervals immediately above observed debris, immediately below the debris, and within the approximate center of the observed debris layer. At boring SB-205, debris was observed from approximately three to six feet below ground surface (bgs). Given the depth of the debris relative to the saturated zone (saturated conditions were observed at a depth of approximately 4 to 5 feet), it was decided (with EPA concurrence) to not attempt to collect a sample below the debris at this location. Thus, sampling was not performed below the 3 to 4 foot depth interval sample at this location.

Soil borings were drilled using DPT methods and soil samples were collected using a butyrate-lined, split-spoon sampler. Sub-samples for VOC analyses were collected for the soil core barrels using EnCore® samplers.

2.5.3 Wetland Sediments

In accordance with Section 5.6.7 of the Work Plan, RI wetland sediment samples were initially collected for chemical analysis from the 0 to 0.5 foot depth interval at 17 Phase 1 locations (locations with sample suffix designations "–SE01" through "–SE17" as shown on Figure 12). At 10 of these locations, where saturated conditions were not encountered at depths less than 2 feet, samples were also collected from the 1 to 2 foot depth interval. In addition, 17 Phase 2 wetland sediment samples (2WSED1 through 2WSED17 on Figure 12) were collected from on-site and off-site locations selected (with concurrence from EPA) based on field observations, particularly with regard to potential drainage areas. Based on the Phase 1 and 2 sample data, ten additional samples (locations 3WSED1 through 3WSED9, and 4WSED1 on Figure 13) were collected. Two other locations (4WSED2 and 4WSED3) were also sampled at EPA's request.

Depending on the sample location and desired sample depth, wetland sediment samples were collected using either a stainless steel spoon, disposable plastic trowel or a hand coring sampler. Sediment was placed into a stainless steel bowl and a sub-sample immediately removed with stainless steel spoon and placed into the sample container for VOC analysis, or sediment for VOC analysis was directly transferred from the sampling device to the sample container. The remainder of the sample was then homogenized and placed in containers for other analyses.

2.5.4 Wetland Surface Water

Section 5.6.6 of the Work Plan specified the collection of surface water samples from 15 locations (both on-site and off-site) within the wetlands north of Marlin Avenue. Based on field reconnaissance and subsequent discussions with EPA during 2006 (Table 2), the number of proposed surface water sample locations was subsequently revised to six locations due to the general lack of ponded surface water in the area. Sampling at these locations was performed on December 6, 2006. Surface water was not present at two sample locations at that time, and in consultation with EPA, it was determined that only four wetland surface water locations would be sampled. These four sample locations are shown on Figure 12.

RI wetland surface water samples were collected using a peristaltic pump. Prior to sampling, the water collection apparatus (pre-cleaned Teflon and C-flex tubing attached to a 5 micron pre-filter and a 0.45 micron final filter) was purged for two (2) minutes. Following the system purge, a filtered water sub-sample (for dissolved metals analyses) was collected directly into a sample container. The water filters were then removed from the sample tubing and an unfiltered water sample (for all other analyses) was collected. Field measurements of pH, temperature, conductivity, salinity, DO, ORP, and turbidity were recorded during sampling. These field measurements are included in the analytical database provided in Appendix B.

2.5.5 Ponds Sediments

In accordance with Section 5.6.7 of the Work Plan, RI sediment samples were collected from five locations within the "Fresh Water Pond" on Lot 55 in the North Area and three sediment samples were collected from the smaller pond to the southeast (referred to as the "Small Pond" hereafter). Sample locations are plotted on Figure 12. At all locations, sediment samples were collected from the 0 to 0.5 foot depth interval. It should be noted that although the name "Fresh Water Pond" has been retained to correlate with the use of this name throughout the operational history of the Site (see Section 1.2.2), field measurements of specific conductance (approximately 40,000 micromhos per centimeter (µmhos/cm)) and salinity (approximately 25 parts per thousand) indicate generally brackish water in the pond.

Fresh Water Pond sediment samples were collected using an Ekman grab sampler. Small Pond sediment samples were collected using a stainless steel spoon. In both cases, sediment was placed into a stainless steel bowl and a sub-sample immediately removed with a stainless steel spoon and placed into the sample container for VOC analysis. The remainder of the sample was then homogenized and placed in containers for other analyses.

2.5.6 Ponds Surface Water

As specified in Section 5.6.6 of the Work Plan, RI surface water samples were collected from three locations within the "Fresh Water Pond" and three locations within the "Small Pond". Sample locations are plotted on Figure 12. As noted above, water in the "Fresh Water Pond", which was approximately 4 to 4.5 feet deep at the three sample locations, is relatively brackish. Water in the much shallower 'Small Pond" (depth of approximately 0.2 feet when sampled in July 2006 and nearly dry in June 2008) is less brackish based on specific conductance (approximately 14,000 µmhos/cm) and salinity (approximately eight parts per thousand) measurements.

Pond surface water samples were collected using a peristaltic pump as described above for wetland surface water samples with both filtered and unfiltered samples collected. Field measurements of pH, temperature, conductivity, salinity, DO, ORP, and turbidity were recorded during sampling and are included in the analytical database in Appendix B.

2.6 BACKGROUND SOIL INVESTIGATION

Consistent with Section 3.4.3 of the FSP, Site-specific background soil samples were collected from within an EPA-approved background area approximately 2,000 feet east of the Site near the east end of Marlin Avenue (see Figure 1). Soil samples were collected from ten locations within this area, with five samples collected north of Marlin Avenue and five samples collected south of Marlin Avenue as shown on Figure 13. Soil samples were collected from the 0 to 0.5 foot depth interval at each of these sample locations using a disposable plastic trowel.

2.7 GROUNDWATER

Groundwater investigation activities performed at the Site included soil boring drilling, Cone Penetrometer Testing (CPT), monitoring wells/piezometers installation and sampling, deep soil boring geophysical logging, staff gauge installation, water-level measurement, and hydraulic (slug) testing. Investigation activities also included evaluations of the possible presence of NAPL, including both Light Non-Aqueous Phase Liquid (LNAPL) and DNAPL, in Site monitoring wells using an interface probe and/or bailer. The three uppermost water-bearing units at the Site, which are designated from shallowest to deepest as Zone A, Zone B and Zone C, respectively, were evaluated as part of the Site groundwater investigation. A general description of each water-bearing unit and the specific investigation activities performed therein are described below. Details regarding the lithology, structure, hydraulic characteristics, and groundwater flow directions associated with each zone, along with regional groundwater information and Site hydrogeologic cross-sections, are provided in Section 3.4. The extent of contamination in each unit is discussed in Section 4.7. Boring logs and well construction diagrams for the monitoring wells and piezometers installed in each unit are provided in Appendix C.

2.7.1 Zone A

Zone A is the uppermost water-bearing unit at the Site. It consists of poorly graded sand to silty, sandy clay, and is generally first encountered at a depth of 5 to 15 feet bgs (average depth of approximately 10 feet bgs). Zone A ranges in thickness from approximately 2 feet to 10 feet, with an average thickness of approximately 8 feet. Zone A investigation activities included the installation, development and sampling of 24 monitoring wells and 8 temporary piezometers, as listed in Table 3 and shown on Figure 4. Slug tests were performed in three Zone A monitoring wells (ND4MW03, NE1MW04, and SJ1MW15) to provide an estimate of the hydraulic conductivity of the unit.

Soil borings for monitoring wells were advanced using hollow-stem auger drilling methods. Soil samples were collected continuously from each boring as possible (using a split-barrel sampler) and logged in the field for lithology and sedimentary structure. Soil headspace samples were also collected and screened in the field for total organic vapor concentrations using an organic vapor meter (OVM). In addition, soil core samples were visually inspected for NAPL presence. Monitoring wells were constructed using 2-inch diameter, flush-joint-threaded Schedule 40 PVC casing and 0.010-inch slotted PVC screen. The total boring depth and screened interval for each well is listed in Table 3. Once the casing and screen were in place, the remaining well materials (filter sand, bentonite pellets, and cement/bentonite grout) were added to the annular space. Filter sand was typically placed to a depth approximately two feet above the top of the screened interval and a bentonite seal layer (2 feet in thickness) was installed on top of the filter sand. The remainder of the borehole annulus was be filled with a Portland/bentonite grout (or bentonite pellets). Each well was completed above grade with a lockable steel or aluminum protective casing on a 4-foot-by-4-foot or 2-foot-by 2-foot concrete pad. After construction, the position and elevation of each monitoring well was surveyed relative to Texas State Plane Coordinates and mean sea level (MSL).

Well development consisted of surging and bailing or pumping. Temperature, pH, specific conductivity, and turbidity were monitored during the development process. Typically ten casing volumes of water were removed from the well during development.

Temporary piezometers were installed using DPT methods. At each temporary piezometer location, an initial soil boring was continuously sampled for lithologic and soil headspace sample screening purposes. This initial boring was subsequently plugged with bentonite pellets and the temporary piezometer installed in a second boring approximately 5 feet from the original soil boring. Temporary piezometers were constructed of 0.75-inch diameter flush-joint-threaded, Schedule 40 PVC casing with a pre-packed screen assembly and temporary seal. After sampling (as described below) the temporary piezometer was removed and the borehole plugged with bentonite pellets.

Groundwater wells and temporary piezometers were purged and sampled using a peristaltic pump in accordance with low-flow sampling procedures described in the FSP. Typically, purging was performed at a flow rate of 0.2 liter per minute or less, with the pump intake near the middle of the screened interval. Field measurements of pH, temperature, conductivity, salinity, DO, ORP, and turbidity were recorded during sampling. These field measurements are included in the analytical database provided in Appendix B. After purging, groundwater samples were collected directly from the discharge of the pump. If the stabilized turbidity reading was greater than 10 NTU, samples for metals analyses were filtered with an in-line 10 µm filter.

Three staff gauges/benchmarks were installed at the Site to allow comparison of surface water and groundwater elevations. Two staff gauges (BM-1 and BM-2 on Figure 4) were installed at the Fresh Water Pond to provide redundant measurement points due to concerns over possible settlement of the soft sediments in this area. The gauge at the Intracoastal Waterway (BM-3 on Figure 4) consisted of a notch in the concrete bulkhead surface between the two Site barge slips. The position and elevation of each of these staff gauges/benchmarks was surveyed relative to Texas State Plane Coordinates and MSL. Depths to water at these locations were measured in conjunction with comprehensive Site monitoring well water-level measurement events.

Falling-head and rising-head slug tests were performed in selected monitoring wells to estimate the lateral hydraulic conductivity of the water-bearing unit being tested. The slug tests were performed by rapidly submerging (slug-in test) or retracting (slug-out test) a PVC slug of known volume and measuring the resultant water level changes using an electric water-level meter. Slug test data were evaluated in accordance with procedures specified in the FSP. Slug test data and analyses are provided in electronic form in Appendix B.

2.7.2 Zone B

Zone B consists of a silty to well-graded sand that was generally first encountered at a depth of 15 to 33 feet bgs. The average depth to the top of Zone B was approximately 19 feet bgs. Zone B is separated from Zone A by a medium- to high-plasticity clay that ranged in thickness from approximately 2 to 7 feet. Where present, Zone B sands ranged in thickness from as little as one foot to as much as approximately 20 feet, with an average thickness of approximately 11 feet. Zone B investigation activities included the drilling of seven soil borings and the installation, development and sampling of five monitoring wells (Table 3, Figure 4). Monitoring wells were not installed in two Zone B soil borings (NC2B23B and OB26B) as Zone B was not present at those locations. Slug tests were performed in three Zone B monitoring wells (ND4MW24B, NG3MW25B, and OMW27B) to provide an estimate of the hydraulic conductivity of the unit.

In order to minimize the potential for downward migration of contamination from Zone A to Zone B as a result of soil boring drilling or well installation activities, a surface (isolation) casing was installed to the confining clay below Zone A and grouted in place prior to deeper boring advancement and well construction in Zone B. Thereafter, Zone B soil boring drilling, monitoring well installation/development/sampling and slug testing procedures were performed as described above for Zone A.

2.7.3 Zone C

Zone C investigation activities included the installation, development and sampling of one groundwater monitoring well (NE4MW32C) and the installation and sampling of five CPT piezometers (Table 3, Figure 4). At NE4MW32C, Zone C consisted of a thin (less than 0.5 ft thick) shell layer at a depth of approximately 73 feet bgs within a high plasticity clay unit. Approximately 25 or more feet of clay/silty clay separate Zone C from Zone B (where Zone B is present). Two soil samples of this clay material were collected from the NE4MW32C soil boring using a Shelby tube for laboratory vertical hydraulic conductivity testing.

In order to minimize the potential for downward migration of contamination from Zones A and B to Zone C as a result of NE4MW32C soil boring or well installation activities, two isolation casings were installed prior to completion of this boring. First, an isolation casing was installed to the confining clay below Zone A and grouted in place prior to boring advancement below Zone

A. A second isolation casing was then installed inside the first casing to the confining clay below Zone B and grouted in place prior to deeper boring advancement and well construction. Thereafter, NE4MW32C soil boring drilling, and monitoring well installation/development/ sampling, and slug testing procedures were performed as described previously.

In order to minimize the potential for downward migration of contamination, the five Zone C CPT borings were located in areas where no evidence of contamination had been identified in Zones A or B. The CPT borings were advanced using a track-mounted CPT unit. The CPT probe was combined with a Membrane Interface Probe (MIP) to provide a real-time indication of the possible presence of VOCs in the subsurface at the CPT boring locations. Upon reaching the target depth, the CPT probe was withdrawn and the boring backfilled with a cement-bentonite grout emplaced by tremie pipe from the bottom of the hole to the surface. Using the estimated lithology from the CPT boring, hollow push rods with a disposable tip were advanced to Zone C in a separate borehole adjacent to each CPT boring. A 0.75-inch diameter piezometer was installed through the push rods. The push rods were withdrawn from the boring leaving the disposable tip and piezometer materials in place. Piezometer materials included a 10-foot screen with a pre-packed filter pack (except for piezometer OCPT5, which, at EPA's request, was constructed with a 5-foot blank section between two 5-foot screen sections) and bentonite seal. The annular space above the bentonite seal was filled with a cement-bentonite grout. Each piezometer was completed above grade with locking protective steel casing within a 2 foot by 2 foot concrete pad. Piezometers were sampled using the low-flow sampling methods described previously. The CPT profiles, including MIP measurements, for these borings are provided in Appendix D.

2.7.4 <u>Deep Soil Boring</u>

As specified in Section 5.6.5 of the Work Plan, a deep soil boring (SE1DB01, Figure 4) was advanced to a depth of 200 feet bgs using mud rotary drilling techniques. In order to minimize the potential for downward migration of contamination, the boring was located outside the area of groundwater contamination as indicated by existing data. The purpose of this boring was to evaluate the subsurface stratigraphy at depths below affected water-bearing units and above water-bearing units that might have the potential for use as a water supply. During drilling, cuttings were lithologically logged by a field geologist, and upon reaching total depth the borehole was geophysically logged for Spontaneous Potential (SP); resistivity (single point, short and long normal); and natural gamma. In addition, a Shelby tube sample was collected from the 80 to 82 foot depth interval for laboratory vertical hydraulic conductivity testing. After completion of geophysical logging, the borehole was backfilled with cement/bentonite grout placed by tremie pipe. The SE1DB01 boring log is included in Appendix C. The geophysical logs for this boring are provided in Appendix E.

3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA

3.1 SURFACE FEATURES

As described in Section 1.2.1, the Site consists of approximately 40 acres along the north bank of the Intracoastal Waterway and is located within the 100-year coastal floodplain (FEMA, 2009). The South Area includes approximately 20 acres of upland created from material dredged from the Intracoastal Waterway. Most of the North Area is considered wetlands although there are some upland areas, also created from dredged spoil material. As indicated by the topographic map in Figure 1, the Site ground surface is very flat. This generally flat topography is also illustrated by the surveyed ground surface elevations at the monitoring well/piezometer locations (Table 3), which range from 1.5 feet above MSL at location OCPT5 north of the Site (Figure 4) to 5.6 feet above MSL at location SD3PZ08 within the South Area interior.

3.1.1 South Area

Within the South Area, the two most significant surface features are the Former Dry Dock and the AST Tank Farm. The remainder of the South Area surface consists primarily of former concrete laydown areas, concrete slabs from former Site buildings, gravel roadways and sparsely vegetated open areas with some localized areas of denser brush vegetation, particularly near the southeast corner of the South Area.

Former Dry Dock

The Former Dry Dock is located in the northwest part of the South Area (Figure 2). This inclined soil ramp has a concrete surface and extends from the northern end of the western barge slip north to near Marlin Avenue. At its peak, the dry dock extends to an elevation of approximately 12 feet above the surrounding grade with a near vertical drop on its north side.

AST Tank Farm

The AST Tank Farm consisted of 15 tanks located within two concrete containment areas adjacent to the eastern Site barge slip (Figure 14). As described in Section 1.0, this area was used for storage of product heels and wash waters associated with barge cleaning operations. Some vapor control equipment (e.g., an air stripping tower) from the former barge cleaning operation also remained in this area after cessation of Site operations. As noted previously, a TCRA was recently performed to remove residual materials in the Tank Farm ASTs and then demolish the tanks. Details of this TCRA are documented in the Final Removal Action Report (PBW, 2011).

3.1.2 <u>North Area</u>

The most significant surface features in the North Area are the two ponds (the Fresh Water Pond and the Small Pond) and the former surface impoundments. The former surface impoundments and the former parking area south of the impoundments and Marlin Avenue comprise nearly all of Lot 56 (Figure 2) and the vast majority of the upland area within the North Area (Figure 3). As discussed previously, the remainder of the North Area consists of marine wetlands. The small irregularly shaped area within the wetlands immediately north of the Fresh Water Pond (Figure 2) is a salt panne, a shallow depression that retains sea water for short periods of time such that salt accumulates to high levels over multiple flooding/extreme tide cycles (during the BERA field sampling in August 2010, a surface water salinity of 43 parts per thousand was measured in this area).

<u>Ponds</u>

As noted previously, water in the Fresh Water Pond is approximately 4 to 4.5 feet deep and is relatively brackish. This pond appears to be a borrow pit created by the excavation of soil and sediment as suggested by the well-defined pond boundaries and relatively stable water levels (see discussion in Section 3.3.3 below). In contrast, the Small Pond is a very shallow depression that is not influenced by daily tidal fluctuations and behaves in a manner consistent with the surrounding wetland, i.e., becomes dry during dry weather, but retains water in response to and following rainfall and extreme tidal events. As described in Sections 2.5.5 and 2.5.6, sediment and surface water samples were collected from both the Fresh Water Pond and the Small Pond. Analytical data for these samples are discussed in Sections 4.5.4 and 4.5.5.

<u>Former Surface Impoundments</u>

The former surface impoundments consist of three earthen lagoons used for the storage of wash waters generated from barge cleaning operations. Covering an area of approximately 2.5 acres combined, the impoundments were reportedly three feet deep with a natural clay liner (TNRCC, 2000a). The impoundments were closed in 1982 with closure activities reported to include: (1) removal of liquids and most of the contained sludges; (2) solidification of approximately 100 cubic yards of residual sludge that was difficult to excavate; (3) and capping with three-feet of clay and a hard-wearing surface (Guevara, 1989). As shown on a topographic survey of the area (Figure 15), the impoundments cap extends approximately 1.5 to 2.5 feet above the surrounding grade. The cap crown slope is about 2% with slopes of 5 to 1 (horizontal to vertical) or less at the cap edge.

As described in Section 2.5.1, four soil borings were drilled through the impoundment caps and soil samples were tested to evaluate the construction materials and thickness of the caps. As shown in Table 4, the surface impoundment cap thicknesses at the four boring locations ranged from 2.5 feet to greater than 3.5 feet. The geotechnical properties (Atterberg Limits and Percent Passing # 200 Sieve) of the cap material as listed in Table 4 are consistent with those recommended for industrial landfill cover systems in TCEQ Technical Guideline No. 3 (TCEQ, 2009a) and the vertical hydraulic conductivities were all better (i.e., less) than the TCEQ guideline value of 1×10^{-7} centimeters per second (cm/sec).

A detailed field inspection of the cap was performed on August 3, 2006. The cap appeared to be in generally good condition with no significant desiccation cracks or erosion features observed on the cap surface or slopes. The cap surface consisted of a partially vegetated crushed oyster shell surface overlying the clay layer. Some sporadic indications of animal (e.g., crab) penetrations of the cap surface were observed. Occasional debris (e.g., scrap wood and telephone poles) was present on the surface and several large bushes (approximate height of three feet) were observed, mostly near the cap edges. Drilling rig and other heavy equipment (i.e., support truck) traffic across the western end of the cap in conjunction with Site investigation activities has resulted in surface rutting of the cap in this area. A follow-up cap inspection was performed on September 17, 2008 to assess potential damage to the cap as a result of Hurricane Ike. No visible damage from the hurricane storm surge or associated effects was observed.

3.2 METEOROLOGY

The most complete current and historical source of meteorological data in the general vicinity of the Site is provided by the weather station located at Scholes Field in Galveston, Texas. Some additional data closer to the Site are available for several cooperative stations located in the Freeport area. Scholes Field is located approximately 33 miles northeast of the Site. Based on data collected from 1971 through 2000, the mean annual temperature in this region is 71.2°F, with mean monthly temperatures ranging from 55.8° F in January to 84.4° F in July (NOAA, 2009a). The normal annual rainfall accumulation in the region is 43.84 inches, with average monthly accumulations ranging from 2.56 inches in April to 5.76 inches in September (NOAA, 2009a). Data from the Dow Texas Operations - Freeport, Texas - Meteorological Station, located approximately 6 miles west of the Site, indicated an average annual rainfall accumulation of 47.94 inches, an average low temperature of 63° F, an average high temperature of 78° F, and a mean annual temperature of 70° F for the 5-year period from 2004 through 2008 (Dow, 2009).

The closest location to the Site for which historical wind data are available is the George Bush Intercontinental Airport in Houston (TCEQ, 2009b). Figure 16 provides a wind rose for data collected from 1984 to 1992 at this location. As shown on this figure, the predominant wind directions are from the southeast and south.

Due to its location on the Texas Gulf Coast, the Site is subject to significant rainfall events including tropical storms and hurricanes. Data from Henry and McCormack (1975), as presented in Roop et al. (1993), indicate an average frequency of 4 years between all hurricanes, and an average frequency of 16 years between extreme hurricanes for the Freeport area. During the period of RI field activities, three major storms struck the Gulf Coast with impacts observed in the Freeport area (Tropical Storm Humberto in September 2007, Hurricane Edouard in August 2008, and Hurricane Ike in September 2008). Tropical Storm Humberto's and Hurricane Edouard's impacts were more severe in other areas of the state and resulted in only minor storm surges in the Freeport area. Hurricane Ike resulted in significant impacts to the Freeport area, with a storm surge of 6.25 feet and maximum sustained surface winds of approximately 51 miles per hour reported (NOAA, 2009b). A mandatory evacuation of the community of Surfside, Texas (see Figure 1 for location) and sections of Freeport, including the Site vicinity, was ordered as areas seaward of the Freeport Levee (Figure 1) were completely inundated by the storm surge.

Hurricane Ike's impact at the Site included: (1) significant damage to the Site fence on the south side of Marlin Avenue; (2) destruction of an electrical power pole and three inactive electrical transformers in the South Area; (3) damage/destruction/removal of multiple drums of investigation-derived waste (IDW), primarily soil cuttings and well development/purge water; (4)

demolition of a temporary project trailer; and (5) removal of an empty AST (Tank No. 100) from the AST Tank Farm. Post-storm inspections by GRG and EPA representatives did not indicate significant damage to tanks in the AST tank farm, Site monitoring wells, or the former surface impoundments cap. Soil samples collected adjacent to the damaged electrical transformers did not contain detectable polychlorinated biphenyls (PCB) concentrations. An inventory of IDW drums was performed and it was determined that the drum contents released did not exceed the reportable quantities for the hazardous substances they contained. Recovered drums/drum contents were subsequently transferred to roll-off bins and removed from the Site.

3.3 SURFACE-WATER HYDROLOGY

Surface water bodies at/adjacent to the Site are discussed below by area. The Intracoastal Waterway, including two Site barge slips, is the sole surface water body in the South Area. North Area surface water bodies include the Fresh Water Pond, the Small Pond, and areas of intermittent ponded water immediately south and northeast of the Former Surface Impoundment Area as shown on Figure 12.

3.3.1 Intracoastal Waterway

The Intracoastal Waterway extends 423 miles along the Texas Gulf Coast and includes approximately 1,200 feet of shoreline along the southeast perimeter of the Site. The Intracoastal Waterway is less than 25 feet deep and is defined as a shallow-draft channel by the USACE. The Intracoastal Waterway is the third busiest shipping canal in the United States, and along the Texas coast carries an average of 60 to 90 million tons of cargo each year (TxDOT, 2001). Of the cargo carried through the Intracoastal Waterway between Galveston and Corpus Christi, 49 percent is comprised of petroleum and petroleum products and 38 percent is comprised of chemicals and related products. Approximately 50,000 trips were made by vessels making the passage through the Intracoastal Waterway between Galveston and Corpus Christi in 2006 (USACE, 2006).

Water levels in the Intracoastal Waterway vary with tidal fluctuations. The National Oceanic and Atmospheric Administration (NOAA) maintains a tide-monitoring gauge at the US Coast Guard station at the Freeport Harbor channel approximately 1.8 miles southwest of the Site (National Oceanic Service Stations ID No. 8772447). The mean tidal range (defined as the difference in height between mean high water and mean low water) for this station is reported as 1.41 feet

(NOAA, 2009c). As described in Section 2.7.1, on-site staff gauge BM-3 (notch in the concrete bulkhead surface between the two Site barge slips) was used to measure Intracoastal Waterway water levels in conjunction with groundwater level measurement events. Measurements from this gauge are discussed in the context of groundwater levels in Section 3.4.5 below.

Shoaling, or the buildup of bottom sediments in the channel, normally occurs in the Intracoastal Waterway due to natural forces of wind, waves and currents, and rain. Sediment deposition due to erosion is a major factor along the Texas Gulf Coast with approximately 45 percent of the shoreline and 56 percent of the vegetation line receding between 1974 and 1982 (Roop et al., 1993). Ship/barge wakes and wind-driven waves along the banks of the Intracoastal Waterway cause additional erosion, with the effects increasing as the channel widens. Sediment enters the channel from several different sources, including the channel banks, water surface, river run-off, and from the Gulf. The shoaling rates at measurement points near the Site (Intracoastal Waterway Mile 394) are 1.02 feet per year (ft/year) (Intracoastal Waterway Mile 377.6) and 1.28 ft/year (Intracoastal Waterway Mile 398.5) (Roop et al., 1993).

The Intracoastal Waterway design width and depth in the vicinity of the Site, based on USACE mean low tide datum, is 125 feet wide and 12 feet deep (USACE, 2008). The Intracoastal Waterway is maintained by periodic dredging operations conducted by the USACE as frequently as every 20 to 38 months, and as infrequently as every 5 to 46 years (Teeter et al., 2002). A September 2008 survey indicated that actual channel depths in the 19-mile reach from Chocolate Bayou to Freeport Harbor, which includes the Site vicinity, ranged from 9.3 to 11.1 feet (USACE, 2008). According to the USACE (USACE, 2009), the Intracoastal Waterway in the immediate vicinity of the Site is not currently scheduled for dredging, although dredging is performed approximately every three to four years and the area to the west near Freeport Harbor (Intracoastal Waterway Mile 395) was dredged in 2009.

Sediments within the Intracoastal Waterway exhibit variable characteristics due to sediment re-entrainment and deposition caused by dredging, vessel traffic, and tidal currents. During the RI, sediment samples were collected from areas on both sides of the main channel, adjacent to the Site on the north side of the channel (Figure 8), and from the background area on south side of the channel (Figure 7). Accumulated soft sediment was generally not present in the main channel area as indicated by the absence of sediment at proposed sample locations IWSE35 and IWSE36 (Figure 8), as described in Section 2.3.1. Similarly, the location of the background area was revised, with EPA concurrence, from that originally proposed in the Work Plan to an alternate location due to a lack of soft sediment in the originally proposed area. The general lack of soft sediment within the main Intracoastal Waterway is likely attributable to the aforementioned maintenance dredging as well as scouring effects due to the frequent ship/barge traffic through the area.

As shown on Table 5, grain size analyses conducted on sediment samples obtained from the sides of the Intracoastal Waterway channel adjacent to the Site during the RI show that this area contains a greater percentage of gravel and sand, and fewer fines (silt and clay), than the barge slip or background sample areas (mean distributions of 60.2% fines versus 71.2% fines, respectively). As expected, this pattern of distribution suggests that the sorting and deposition of suspended sediment is a function of the relationship between sediment density and wave and current energy, i.e., fines are more predominant in more quiescent, low energy areas such as the barge slips, than in higher energy areas adjacent to the main channel.

The organic carbon content of Intracoastal Waterway sediment samples was generally low. As shown on Table 6, total organic carbon (TOC) concentrations in Site Intracoastal Waterway samples ranged from less than the sample detection limit of 146 mg/kg (i.e., less than 0.015%) to 7,520 mg/kg (0.75%). TOC concentrations in Intracoastal Waterway background sediment samples were generally similar, ranging from less than 146 mg/kg to 8,030 mg/kg (0.8%). These values are generally within the range of concentrations reported for lower-estuary sediments in Galveston Bay (0.3 to 0.8% per Zimmerman and Benner, 1994).

3.3.2 Wetlands

Field observations during the RI indicate that the North Area wetlands are irregularly flooded with nearly all of the wetland area inundated by surface water that can accumulate to a depth of one foot or more during extreme high tide conditions, storm surge events (e.g., during Hurricane Ike), and/or in conjunction with surface flooding of Oyster Creek northeast of the Site (Figure 1). Due to a very low topographic slope and low permeability surface sediments, the wetlands are also very poorly draining and can retain surface water for prolonged periods after major rainfall events. Under normal tide conditions and during periods of normal or below normal rainfall, standing water within the wetlands (outside of the two ponds discussed below) is typically limited to the small, irregularly shaped panne area immediately north of the Fresh Water Pond discussed previously and a similar area immediately south of the former surface impoundments (see Figure 2). Depending on rainfall and tide conditions, both of these areas can often be completely dry, as was observed on several occasions during the RI.

As shown in Table 5, wetland sediments were typically more fine-grained than the Intracoastal Waterway sediments, with an average distribution of 79.7% fines in the wetland samples. Only four wetland sediment samples tested for grain-size distribution contained less than 50% fines and only five wetland sediment samples contained greater than 10% gravel-size material.

As expected, the organic carbon content of the wetland sediment (Table 6) was higher than that of the Intracoastal Waterway sediments. TOC concentrations of wetland sediment samples ranged from below the sample detection limit of 146 mg/kg to 59,400 mg/kg (5.9%). The upper range of these values is slightly higher than the range of concentrations reported for salt marsh sediments in Lavaca, Matagorda and Carancahua Bays (0.1 to 1.4%, per Brown et. al., 1998).

3.3.3 Ponds

The Small Pond located in the eastern corner of the North Area is typical of the shallow surface water found in the wetlands area. The Small Pond is not influenced by daily tidal fluctuations and behaves in a manner consistent with a salt panne (i.e., becomes dry during dry weather, but retains water in response to and following rainfall and extreme tidal events). During the July 2006 surface water sampling event, the depth of water in the Small Pond was about 0.2 feet, with a specific conductance of approximately 14,000 µmhos/cm and salinity of approximately 8 parts per thousand. In August 2010, the salinity of water in the Small Pond was 42 parts per thousand. The Small Pond was observed to be nearly dry during June 2008. Sediment samples collected from the Small Pond were characterized by grain size distributions similar to other North Area wetland sediments with a mean composition of 5.4% sand and 91.6% fines. TOC concentrations in Small Pond sediment samples ranged from less than the sample detection limit of 146 mg/kg to 21,500 mg/kg (2.1%).

The Fresh Water Pond, located in the northeast portion of the North Area, is believed to be a former borrow pit due to its steep and well-defined sides (relative to the Small Pond) and exterior dikes. The pond is not visible on the 1977 aerial photograph of the Site vicinity, but was created some time thereafter and is clearly visible on a 1985 aerial photograph (see Appendix A).

Although, the name "Fresh Water Pond" has been retained due to the historical use of this name (see Section 1.2.2), field measurements of specific conductance (approximately 40,000 µmhos/cm) and salinity (approximately 25 parts per thousand) indicate generally brackish water in the pond.

Unlike the Small Pond and surrounding wetland areas, water levels in the Fresh Water Pond are not influenced by periodic extreme tidal fluctuations since the pond dikes preclude tidal floodwaters in the wetlands from entering the pond (except for extreme storm surge events such as observed during Hurricane Ike). The depth of water in the Fresh Water Pond was measured at 4 to 4.5 feet during a July 2006 sampling event, with no appreciable change in water depth noted during a June 2008 sampling event. Water level measurements were collected from staff gauges installed at the southern (BM-1) and northern (BM-2) ends of the pond (Figure 4). As discussed in Section 2.7.1, these two staff gauges were installed to provide redundant measurement points due to concerns over possible settlement of the soft sediments in which the gauges were installed. Water levels measured at the staff gauges on six dates between October 2006 and July 2008 are listed in Table 7. Water levels at the two gauges were consistent until June 2008. Thereafter, BM-1 water levels were nearly one foot higher than those at BM-2. This inconsistency is attributed to settlement of the BM-1 gauge as confirmed by visual inspection. As a result, the BM-2 levels are considered representative of the Fresh Water Pond water level. The hydrologically isolated nature of the Fresh Water Pond (from both tidal and groundwater influences) is indicated by consistency of the BM-2 water levels relative to significantly more variable Intracoastal Waterway water levels and similarly variable groundwater levels in nearby well NF2MW06. As shown on Table 7, the minimum and maximum water levels at BM-2 varied by only 0.47 feet for the six measurement dates between October 2006 and July 2008. In contrast, Intracoastal Waterway staff gauge BM-3 water levels varied by 1.09 feet and NF2MW06 water levels varied by 1.66 feet during the same period.

Sediment samples collected from the Fresh Water Pond were characterized by grain size distributions similar to other North Area wetland sediments with a mean composition of 6% sand and 94% fines. TOC concentrations were below the sample detection limit in all five Fresh Water Pond sediment samples.

3.4 GEOLOGY AND HYDROGEOLOGY

3.4.1 Regional Geologic and Hydrogeologic Setting

Brazoria County is located within the Texas Coastal Zone of the Gulf Coast Plain physiographic province. The area is defined by a low-lying coastal plain that rises from sea level in the south and east to the Coastal Uplands to the north and west. Several major rivers cut across the Coastal Plain to the Gulf of Mexico. The Site lies between the Brazos River to the west and the San Jacinto River to the east.

The surficial geology of the Gulf Coast Plain is fairly complex due to the variety of active geologic environments occurring in the region (Chowdhury and Turco, 2006). Active geologic environments in the coastal zone include fluvial-deltaic, barrier-strandplain-chenier, bay-estuary-lagoon systems, eolian systems, marsh-swamp systems, and offshore systems. The Site is located in an area of a Modern-Holocene Colorado-Brazos River Delta system and a Modern marsh system (McGowen et al., 1976) and the surficial geology of the site is predominantly Quaternary alluvium with some "fill and spoil" from the construction of the Intracoastal Waterway (Barnes, 1987), as shown on Figure 17. The alluvium consists of clay, silt, sand and gravel, with abundant organics within the soil horizon. The fill and spoil material consists of dredged material "for raising land surface above alluvium and barrier island deposits and creating land" (Barnes, 1987) as noted in Section 1. This spoil material is highly variable with mixed mud, silt, sand, and shell (McGowen et al., 1976).

Tertiary to Quaternary coastal and marine sediments deposited in the Gulf of Mexico Basin underlie surface sediments in the region. The Gulf of Mexico Basin formed in the late Triassic through the downfaulting and downwarping of Paleozoic rocks during the breakup of Pangaea and the opening of the North Atlantic Ocean. Deposition was affected by basin subsidence, sediment dispersal, and sea-level changes (Chowdhury and Turco, 2006). Basin subsidence and a rising land surface resulted in a Gulfward thickening of Cenozoic sediments, which become tens of thousands of feet thick at the coastline (Baker, 1979). The combination of basin subsidence, eustatic sea-level changes, and faulting have resulted in numerous discontinuous and overlapping beds of sand, silt, clay, and gravel (Chowdhury and Turco, 2006).

In Brazoria County, only the Beaumont Clay and Quaternary alluvium are exposed at the surface, while only the alluvium is exposed near the Site (Figure 17). Older, underlying units outcrop further to the north and west in bands that are roughly parallel to the present coastline (Sandeen and Wesselman, 1973). The dip of these formations is greater than the slope of the land surface; therefore, they occur at a greater depth towards the Gulf (Baker, 1979).

As depicted on the regional stratigraphic column in Figure 18, the geologic units encountered below the Quaternary alluvium are as follows (from youngest to oldest):

- **Beaumont Clay** The Pleistocene-aged Beaumont Clay lies stratigraphically beneath the alluvium and consists of clay, silt, and sand deposits (Solis, 1981). The Beaumont was mostly deposited by rivers as levees and deltas, which coalesced as river mouths shifted along the coast. To a lesser extent, the formation was deposited by marine and lagoonal systems in bays and embayments between the levees and deltas (Sellards et al., 1932).

- **Lissie Formation** The Lissie Formation is Pleistocene in age and outcrops about 20 to 30 miles from the coast in a band that is about 30 miles wide. The Lissie Formation was deposited as continental floodplain muds and delta sands, silts, and mud at river mouths (Sellards et al., 1932). The base of the Lissie Formation is often marked by caliche layers (Price, 1934).

- **Goliad Formation** The Pliocene-aged Goliad Formation unconformably overlies the Fleming Formation (Solis, 1981). The Goliad Formation is an unconsolidated coarse-grained sand with interbeds of calcareous clay, marl, and clayey sand (Solis, 1981).

- **Fleming Formation** The Miocene-aged Fleming Formation is composed of calcareous shale and clay with minor amounts of feldspar, chert, and thin layers of calcareous sandstone (Solis, 1981). The Fleming Formation is lithologically similar to the underlying Oakville Sandstone, but can generally be separated by its higher percentage of clay (Baker, 1979).

- **Oakville Sandstone** The Miocene Oakville Sandstone is composed of terrigenous clastic sediments that form sand and clay interbeds. The Oakville Sandstone has an unconformable contact with the underlying Catahoula Formation (Baker, 1979).

- **Catahoula Tuff or Sandstone** The Catahoula tuff or sandstone is Miocene in age. In the subsurface, the Catahoula has been subdivided from oldest to youngest into the Frio, Anahuac, and the upper Catahoula. In the outcrop, the Catahoula is a pyroclastic and tuffaceous unit (Baker, 1979).

These Miocene to Holocene sediments described above form the Gulf Coast aquifer, which is classified as a major regional aquifer by the Texas Water Development Board (TWDB). This aquifer contains five separate hydrostratigraphic units, as shown in Figure 18. These units are distinguished based primarily on lithologic distinctions as discussed in further detail below.

The uppermost hydrostratigraphic unit within the Gulf Coast aquifer is the Chicot aquifer. The Chicot includes Pleistocene and Holocene alluvium, the Beaumont Clay, the Lissie Formation, and the Willis Sand (Baker, 1979). The Chicot aquifer is subdivided into an upper and lower unit, which are typically subdivided by a clay layer. In Brazoria County, groundwater in the upper unit occurs under unconfined to confined conditions while the lower unit is characterized as containing groundwater under confined to leaky-confined conditions (Sandeen and Wesselman, 1973). In the subsurface, the Chicot aquifer is distinguished from the underlying Evangeline aquifer by a higher sand to clay ratio (Baker, 1979). Additionally, basal Chicot sands often display a higher resistivity than the Evangeline (Sandeen and Wesselman, 1973). In southern Brazoria County, the base of the upper Chicot is present at about 300 feet below MSL and the base of the lower Chicot is present at about 1,200 feet below MSL (Sandeen and Wesselman, 1973) as shown on the regional hydrogeologic cross section in Figure 19.

The Evangeline aquifer is formed by the Goliad Sand (Baker, 1979). The lithology of the aquifer consists of alternating sand and clay layers with individual sands beds reaching thicknesses of up to 100 feet (Sandeen and Wesselman, 1973). The aquifer is wedge shaped and reaches a thickness of about 3,500 feet along the coast in Brazoria County (Sandeen and Wesselman, 1973). Baker (1979) shows an aquifer thickness of about 2,000 feet in south-central Brazoria County (Figure 19).

The Upper Chicot aquifer is the main source of potable groundwater in Brazoria County. Groundwater becomes slightly saline (1,000 to 3,000 milligrams per liter (mg/L) total dissolved solids (TDS)) in the Lower Chicot and within Brazoria County only the uppermost sections of the Evangeline aquifer contain fresh water. Wells completed in Upper Chicot sands that are at least 50 feet thick may produce water up to 500 to 1,000 gallons per minute (gpm). Wells in the Lower Chicot can produce as much as 3,000 gpm (Sandeen and Wesselman, 1973).

The Burkeville confining system underlies the Evangeline aquifer, separating it from the underlying Jasper aquifer. The Burkeville is primarily silt and clay with a thickness that typically ranges from about 300 to 500 feet thick. As shown on Figure 19, the Burkeville is about 300 feet thick in southern Brazoria County. Although it contains individual sand layers with fresh to slightly saline water, when compared to the overlying and underlying Evangeline and Jasper aquifers, the Burkeville functions more as an confining unit (Baker, 1979).

The Jasper aquifer is formed by the Oakville Sandstone and ranges in thickness from about 200 feet to 3,200 feet. The Jasper is underlain by the Catahoula confining system. Although fresh to slightly saline water can be found in the Jasper aquifer to depths greater than 3,000 feet below MSL, in Brazoria County the aquifer only contains saline water. The aquifer thickens towards the coast and it generally becomes highly saline in the areas of greatest thickness (Sandeen and Wesselman, 1973).

Water quality within the Gulf Coast aquifer is generally good within the aquifer outcrop areas to within 10 to 30 miles of the coast. Near the coast, including coastal areas of Brazoria County around the Site, groundwater within the Gulf Coast aquifer is characterized as brackish with TDS concentrations greater than 1,000 mg/L (Seifert and Drabek, 2006), twice the secondary drinking water standard of 500 mg/L. In addition to these naturally brackish conditions, reductions in groundwater table elevations within the Gulf Coast aquifer due to groundwater withdrawals have caused saltwater intrusion along the coastal areas of the central part of the aquifer, including Brazoria County (Chowdhury et al., 2006). Significant historical saltwater intrusion into the Gulf Coast aquifer has been observed in the vicinity of Galveston Island, northeast of the Site. Recent decreases in groundwater withdrawals have resulted in stabilized groundwater quality and less saltwater intrusion (Ashworth and Hopkins, 1995).

3.4.2 Water Well Survey Findings

In accordance with Section 5.6.4 of the Work Plan, an inventory of water wells within a ½-mile radius of the Site was conducted to locate any water supply wells in the vicinity. A records search contractor (Banks Information, Inc. (Banks)) performed an initial search of TWDB and TCEQ water well records within a ½-mile search radius in 2006. Based on the findings of the records search, PBW then performed a field survey to confirm the location of the wells identified within the ½-mile radius of the Site by the records search. Next PBW contacted representatives from local water suppliers and property owners identified as possessing a well identified in the records search to confirm the records search data. Lastly, an updated records search and follow-up conversations with water suppliers were performed in 2009 to confirm that no water supply wells had been installed since the initial evaluation.

The findings of the water well survey are described below. Locations of identified wells are shown on Figure 20 and well records information is summarized in Table 8. The complete records from TWDB/TCEQ files are included as Appendix F.

- Three wells owned by the Surfside Beach Water Department (SBWD) were initially identified by Banks as being located within ½ mile of the Site. PBW contacted the SBWD and was informed that the locations of these wells were mapped incorrectly and that all wells owned and operated by SWDB are located more than ½ mile from the Site.

- The City of Freeport Water Department (CFWD) confirmed that all properties along Marlin Avenue within ½ mile of the Site are serviced by the CFWD. The CFWD uses 100 percent surface water to supply its customers. Although CFWD owns two emergency demand groundwater wells, these wells are located more than ½ mile from the Site.

- Mr. Andrew Patel, the owner of the Bridge Harbor Marina, informed PBW that the marina receives its water from the CFWD and no water supply wells are currently located on the marina property. An abandoned well reported to be formerly located on the marina property is identified as Well No. 5 on Figure 20.

- A well identified by Banks as being owned by the Freeport Marina (Well No. 6 on Figure 20) was field verified to be present, but was capped and not in use. Groundwater in this well is believed to be brackish as indicated by a TDS concentration of 1,460 mg/L reported for a sample collected in April 1967 (included with water well records in Appendix F).

- A well was identified on the property immediately west of the Site (Well No. 2 on Figure 20). This well is present, but based on its condition (partially damaged wellhead, disconnected/damaged power supply); it appears that the well has not been in use for some time. Groundwater in this well is also believed to be brackish as indicated by a TDS concentration of 1,380 mg/L reported for an April 1967 sample (Appendix F).

- The well located on the Site (Well No. 1 on Figure 20) has been mapped incorrectly in the TWDB/TCEQ records. The drillers report indicates this well is a domestic supply well and the well was never field identified. PBW reviewed driller records in an attempt to locate the well, but due to the map scale provided in the records, a more precise and accurate location could not be determined.

- Neither of the two other wells identified by the Banks search could be verified during field reconnaissance. Given the plotted locations of these wells within the Intracoastal Waterway (Well No. 4) or within a wetland area west of the Site (Well No. 3) (Figure 20), these wells are also believed to have been mapped incorrectly in the TWDB/TCEQ records.

3.4.3 Site Hydrogeologic Framework

The shallow subsurface deposits at the Site have been divided into three water-bearing zones, which are designated from shallowest to deepest as Zone A, Zone B, and Zone C, respectively. These zones are defined as a grouping of geologic strata with similar hydrogeologic properties such as texture, lateral extent, thickness, depth of occurrence, and hydraulic conductivity. As illustrated on the idealized hydrostratigraphic column in Figure 21, these individual zones are overlain and separated by zones of lower hydraulic conductivity (Units I through III). The shallow subsurface deposits in the area was deposited in a fluvial-deltaic setting (with the exception of dredge spoil/fill), which has resulted in variations in thickness, geometry, and texture of the zones across the Site. In spite of the lateral and vertical variations typical of this environment of deposition, the Site water-bearing zones occur at relatively consistent depths. These zones have been the focus of the hydrogeologic investigations, and monitoring wells/piezometers are constructed within these water-bearing units.

3.4.4 Lithology and Distribution of Transmissive Zones

The lithology and distribution of transmissive zones at the Site was determined through the evaluation of boring logs, piezometer/monitoring well data, CPT profiles and geophysical logs. This information was used to construct hydrogeologic cross sections, isopach maps, and structure contour maps, which in turn were interpreted to develop the Site hydrogeologic framework described above. Together, the hydrogeologic cross sections provided on Plates 2 and 3, cross section location map (Figure 22), Zone A thickness and structure contour maps (Figures 23 and 24, respectively), and Zone B thickness and structure contour maps (Figures 25 and 26, respectively) illustrate the geometry and thickness of the transmissive zones at the Site. A detailed discussion of each zone is provided below.

3.4.4.1 Zone A

Zone A, the uppermost water-bearing unit at the Site, consists of a heterogeneous mixture of poorly graded sand to silty, sandy clay with typically a high percentage of fine-grained material. The heterogeneous and fine-grained nature of Zone A is typical of overbank flood deposits. Zone A was present in all the borings drilled at the Site and typically was first encountered at a depth of 5 to 15 feet bgs (average depth of about 10 feet bgs). Zone A ranges in thickness from less than 2 feet to more than 14 feet, with an average thickness of about 8 feet. As shown on Figure 23, Zone A is generally thicker in the central areas of the Site. With a couple of exceptions (SA4PZ07 and SJ1MW15), Zone A appears to become thinner towards the west and east portions of the Site. The structure contour map of the base of Zone A (Figure 24) depicts a highly variable surface with elevations ranging from approximately -3 feet MSL to -20 feet MSL. The highest elevations of the base of Zone A generally occur in the southwest and northeast areas of the Site, while the lowest elevations are to the south and west.

Across the site, Zone A is overlain by a firm, medium- to high-plasticity clay (Unit I on Figure 21). The thickness and intrinsically low hydraulic conductivity of the clay serves to hydrostatically isolate Zone A from the surface. Although the land surface at the Site, particularly the North Area, is often inundated with surface water due to extreme high tides, storm surge and/or flooding of Oyster Creek (see Section 3.3.2), water levels within Zone A have not been observed to respond to these events. Rather, it appears that the clayey surficial soils cause the perching of surface water that inundates the Site. Some sandier zones and areas of coarser-grained artificial fill material are present above the Unit I clay overlying Zone A. These zones are generally limited to the near surface, are discontinuous and primarily occur within the South Area or the former parking lot in the North Area.

3.4.4.2 <u>Zone B</u>

Zone B is separated from Zone A by a medium- to high-plasticity clay (Unit II on Figure 21) that typically ranges in thickness from about 2 to 7 feet. This confining unit pinches out in the southeastern part of the Site, as indicated by its absence at monitoring well SL8MW17 (see Cross-Section I-I' on Plate 3).

Zone B is a silty to well-graded sand and is typically first encountered at a depth of 15 to 33 feet bgs. The average depth to the top of Zone B is about 19 feet bgs. Where present, Zone B ranges in thickness from about 20 feet to less than one foot thick with an average thickness of 11 feet. As shown on Figure 25, Zone B is thickest near monitoring well NE4MW31B and thins to the northwest and west where it eventually pinches out. Zone B was not encountered in boring NC2B23B (cross sections A-A' and E-E') in the western part of the North Area and was very thin (0.2 feet thick) in boring OB26B (cross sections A-A' and D-D') north of the Site. Similarly, the Zone B base elevation is highest in the western part of the Site (Figure 26) where it is at its thinnest. The base of Zone B generally dips to the east, with the lowest base elevation observed at Well NE4MW32C where the greatest thickness of the zone was also encountered.

3.4.4.3 <u>Zone C</u>

Zone B is underlain by a thick and highly plastic clay (Unit III on Figure 21) that extends to a maximum depth of approximately 95 feet bgs, as indicated in the geophysical log for deep boring SE1DB01 (included in Appendix E, with the upper 100 feet summarized on cross section B-B' on

Plate 2 and cross section H-H' on Plate 3). Zone C consists of a thin (approximate thickness of one foot or less) shell hash layer within this thick clay unit. One groundwater monitoring well, NE4MW32C was installed into Zone C, which occurred at a depth of about 73 feet bgs and was less than 0.5 feet thick at the well location. Five CPT borings and associated push-in piezometers were also installed in Zone C. The CPT logs (included in Appendix D, summarized in multiple cross sections on Plates 2 and 3) indicated that this zone, which is distinguishable by a decrease in the CPT sleeve friction-to-tip resistance ratio, appeared to be present at all five CPT locations. The projected depth to Zone C was approximately 70 feet bgs at these locations.

As shown on a number of the cross-sections on Plates 2 and 3, approximately 25 feet to 50 feet of the Unit III clay separates Zone C from the overlying Zone B. The vertical hydraulic conductively of this clay, as indicated from two samples collected from the boring for monitoring well NE4MW32C at intervals above Zone C, is extremely low, ranging from 5.7×10^{-9} to 6.6×10^{-9} cm/sec (Table 9). Due to the significant thickness (greater than 25 feet) and the low hydraulic conductivity of the Unit III clay separating Zone B and Zone C, groundwater communication/ flow between these zones is highly unlikely.

Boring SE1DB01 was drilled and geophysically logged (for SP; resistivity (single point, short and long normal); and natural gamma) to a depth of about 200 feet bgs. As noted previously, the geophysical log for this boring (Appendix E) indicated the presence of Unit III clay to a depth of about 95 feet bgs. The vertical hydraulic conductivity of a Unit III clay sample collected from this boring at a depth of approximately 80 feet was measured at 1.6×10^{-8} cm/sec (Table 9).

Three water-bearing sands, as distinguished by gamma log decreases and resistivity log increases, were indicated below the Unit III clay. The first sand occurs at a depth of about 95 feet bgs and is about 8 feet thick. A deeper, thicker sand occurs at a depth of about 120 feet bgs and is about 17 feet thick. The third sand, which appears to have the least amount of fine-grained material of the three (based on the lowest gamma signature), occurs at a depth of about 187 feet to 195 feet bgs. Maximum resistivities to induced current for the three sands (in order from shallowest to deepest) were about 4, 7, and 17 Ohms per meter (Ohms/m). Using the above mentioned resistivities, an inferred porosity of 0.2, and the techniques described by Kwader (1986), the TDS concentrations of the sand bodies occurring at 95 feet bgs, 120 feet bgs, and 187 feet bgs were estimated at approximately 8,000 mg/L, 5,000 mg/L, and 2,000 mg/L, respectively, which indicate brackish to moderately saline water. The estimated TDS concentration of 2,000 mg/L for the deepest sand body (below 187 feet bgs) is generally consistent with the previously noted TDS concentration of 1,380 mg/L in an April 1967 sample from the abandoned water well immediately west of the Site (Well No. 2 on Figure 20), which was reported to be screened over a depth interval of 188 to 199 feet bgs.

3.4.5 Groundwater Movement and Flow Conditions

3.4.5.1 Zone A

Groundwater in Zone A predominantly occurs under confined conditions as indicated by water level elevations in Zone A monitoring wells/piezometers above the top of the unit (see Plates 2 and 3). The Zone A potentiometric surface was evaluated through six water-level measurement events performed between October 2006 and June 2008 (Figures 27 through 32). Water-level measurement data used to develop the potentiometric surface maps are provided in Table 7. Water-level measurement elevations from the previously existing monitoring wells (e.g., MW-1, HMW-1, etc.) were not used in contouring the potentiometric surface due to uncertainties in the construction of these wells. Overall, the Zone A potentiometric surface is relatively flat. The potentiometric maps generally show a groundwater divide near the center of the Site (typically in the North Area). The groundwater flow direction is typically towards the west or northwest in the area north of the divide, and generally flow is to the south and southwest to the south of the divide. The potentiometric surface from the June 17, 2008 monitoring event (Figure 32), which shows a north to northwest flow direction away from the Intracoastal Waterway, was the most noticeable exception to this typical flow direction. That monitoring event occurred during a prolonged dry period.

The Zone A hydraulic gradient is highly variable across the Site, ranging from 0.02 feet/feet (ft/ft) immediately to the northwest of the groundwater divide to less than 0.001 ft/ft in the South Area. The gradient magnitude surrounding the groundwater divide is typically about 0.005 ft/ft.

Slug tests were performed on three Zone A monitoring wells to estimate the hydraulic conductivity of this zone. As shown in Table 10, estimated Zone A hydraulic conductivities ranged from 4 x 10^{-5} cm/sec to 8 x 10^{-5} cm/sec, which are within the range of typical values for a silt to silty sand (Freeze and Cherry, 1979). Based on these estimated hydraulic conductivities and a groundwater gradient of 0.001 ft/ft to 0.02 ft/ft, the specific discharge of Zone A ranges from about 4×10^{-8} cm/sec to 2×10^{-6} cm/sec (0.04 ft/year to 2 ft/year). Dividing this range by a typical porosity of 0.4 for silt (Freeze and Cherry, 1979) yields an average linear groundwater velocity of 0.1 ft/year to 5 ft/year.

Based on the Intracoastal Waterway channel design depth of 12 feet (discussed above), and the Zone A base elevations of approximately -12 ft MSL to -17 ft MSL in soil borings drilled near the shoreline (see Figure 24), it is likely that Zone A intersects the Intracoastal Waterway in areas adjacent to the Site. In the areas where this intersection occurs, the groundwater/surface water discharge relationship likely shows both short-term and long-term variations depending on Zone A potentiometric levels and the tidal stage of the waterway. Regardless of the specific recharge/discharge condition at a given point in time, the net flux between Zone A and the Intracoastal Waterway is likely to be relatively low given: (1) the low hydraulic conductivity of Zone A; (2) the limited thickness of the unit adjacent to the shoreline (less than 12 feet as indicated on Figure 23); and (3) the relatively low magnitude of tidal range fluctuations (mean tidal range of 1.41 feet as described above) within the waterway.

3.4.5.2 <u>Zone B</u>

Groundwater in Zone B also occurs under confined conditions. The Zone B potentiometric surface was evaluated through five water-level measurement events performed between June 2007 and July 2008 (Figures 33 through 37). Water-level measurement data used to develop the potentiometric maps are provided in Table 7. Data from the first water-level measurement events (June 6 and September 6, 2007 as shown on Figures 33 and 34, respectively), indicate an easterly groundwater flow direction. The hydraulic gradient for these events was approximately 0.0006 ft/ft to 0.0009 ft/ft. Data from the three subsequent events (November 7, 2007; December 3, 2007; and July 30, 2008, as shown on Figures 35, 36, and 37, respectively) showed a general flow direction to the northwest. The hydraulic gradient for these events ranged from approximately 0.001 ft/ft to 0.006 ft/ft.

Slug tests were performed on three Zone B monitoring wells to estimate the hydraulic conductivity of this zone. As shown in Table 10, estimated hydraulic conductivities ranged from 2×10^{-5} cm/sec to 5×10^{-4} cm/sec, which is typical of a silty sand (Freeze and Cherry, 1979). Based on an overall groundwater gradient of 0.003 ft/ft and a hydraulic conductivity of 1×10^{-4} cm/sec, the average specific discharge for Zone B is estimated at about 3×10^{-7} cm/sec (0.3

ft/year). Dividing this average by a typical porosity of 0.4 for sand (Freeze and Cherry, 1979) yields an average linear groundwater velocity of 0.8 ft/year.

The vertical hydraulic gradient between Zones A and B was evaluated through a comparison of water-elevations at three sets of paired wells screened in these units during five monitoring events (Table 11). In all but two instances, an upward gradient from Zone B to Zone A (depicted by a negative value in Table 11) was indicated. The magnitude of these upward gradients ranged from 0.02 ft/ft to 0.15 ft/ft. The two observed downward gradients (both for the ND4MW03/ ND4MW24B pair) were 0.02 ft/ft.

3.4.5.3 Zone C

Figures 38 through 41 depict the Zone C potentiometric surface for four water-level measurement evens between June 2008 and January 2009. Water-level measurement data used to develop the potentiometric maps are provided in Table 7. The four potentiometric surface maps suggest a generally northwest groundwater gradient within Zone C. A groundwater divide in the general area of NE4MW32C appears to be present during the September 29, 2008 and January 13, 2009 events (Figures 40 and 41 respectively). The magnitude of the Zone C hydraulic gradient appears relatively uniform across the North Area, typically in the range of 0.005 ft/ft to 0.008 ft/ft.

Vertical hydraulic gradients between Zones B and C were evaluated through comparison of water-level elevations of three pairs of wells screened in these two units for two monitoring events (Table 11). A downward gradient from Zone B to Zone C was indicated in all well pairs for all of the monitoring events. The magnitude of these downward gradients ranged from 0.13 ft/ft to 0.21 ft/ft. Even though a downward vertical hydraulic gradient exists from Zone B to Zone C, there is likely little to no hydraulic communication between the two units. As described previously, more than 25 feet of high plasticity clay with a very low vertical hydraulic conductivity of 6×10^{-9} to 7×10^{-9} cm/sec separates these two zones.

3.4.6 General Groundwater Chemistry

3.4.6.1 Zone A

Groundwater within Zone A has high natural salinity. TDS concentrations in Zone A groundwater samples ranged from 29,900 mg/L to 39,800 mg/L with an average value of 34,850 mg/L. According to the EPA groundwater classification system (EPA, 1988a), water with a TDS concentration greater than 10,000 mg/L is defined as non-potable. Likewise, the TCEQ defines groundwater with a TDS concentration that is greater than 10,000 mg/L as Class 3 groundwater (TCEQ, 2010), which is not considered usable as drinking water. As described previously, EPA's secondary drinking water standard for TDS is 500 mg/L. Due to its natural salinity, Zone A has not been historically used as a water supply source.

Zone A groundwater is circumneutral to slightly alkaline. The pH values for Zone A monitoring wells ranged from 5.8 to 8.0. Zone A groundwater is predominantly a sodium-potassium to chloride type of water ((Figure 42). Alkalinity concentrations ranged from 362 mg/L to 478 mg/L with an average concentration of 411 mg/L.

3.4.6.2 Zone B

Zone B groundwater also has high natural salinity as indicated by a TDS concentration of 34,500 mg/L in a sample from well NG3MW25B. Like Zone A, groundwater in Zone B has not been used as a drinking water source in the vicinity of the Site due to the high natural salinity and is not considered potable. Zone B groundwater is also circumneutral to slightly alkaline. The pH values for Zone B samples ranged from 6.3 to 9.5.

3.4.6.3 Zone C

Although lower than for Zones A and B, groundwater in Zone C also has high natural salinity. The TDS concentration of a sample from Zone C well NE4MW32C was 24,600 mg/L, again far above Class 3 and potability criteria. Zone C groundwater is circumneutral with an average pH of 7.5, ranging from 6.8 to 7.7.

3.4.7 Conceptual Hydrogeologic Model

As investigated in this RI, the shallow subsurface at the Site consists of three water-bearing zones (Zones A, B, and C) that are overlain and separated by zones of lower hydraulic conductivity clays (Units I through III). Groundwater in all three of these units is very saline and occurs under confined conditions. Zones A and B predominantly consist of silty sand, although Zone A is slightly more heterogeneous and has a higher percentage of fine-grained material. The estimated hydraulic conductivities of both zones are in the range expected for a silt to silty-clay. Zone A occurs across the entire Site while Zone B is not present in the western areas of the Site. The low hydraulic conductivity clay separating these units typically ranges in thickness from about two to seven feet, although it is not present in the southeastern part of the Site. Zone C consists of a very thin (less than 0.5 foot thick) layer of shell hash material present at a depth of approximately 75 feet that occurs within the 50- to 75- foot thick Unit III clay.

All three groundwater-bearing zones have relatively flat gradients, typically ranging from 0.001 ft/ft to 0.008 ft/ft. Some steeper gradients up to 0.02 ft/ft are found in Zone A, but are highly localized. Due to their low hydraulic conductivities and these flat hydraulic gradients, all three zones have a relatively low specific discharge rate, resulting in a relatively slow movement of groundwater within each water-bearing zone.

The thickness, continuity and hydraulic conductivity characteristics of the clay units separating the groundwater-bearing zones, along with the vertical gradients between these zones, determine the extent and magnitude of groundwater movement between these units. It is likely that some groundwater movement occurs between Zones A and B in areas where the Unit II clay between these zones is absent (e.g., well SL8MW17) or relatively thin. In other areas where the Unit II clay is thicker, appreciable groundwater flow between these two zones in unlikely. Although a downward gradient exists between Zones B and C, the thick, low vertical hydraulic conductivity (7×10^{-9} cm/sec) Unit III clay layer separating these zones precludes the vertical movement of groundwater between the zones. A similarly thick and low vertical hydraulic conductivity (2×10^{-8} cm/sec) clay beneath Zone C precludes the downward movement of groundwater from Zone C to deeper water-bearing zones.

3.5 LAND USE AND DEMOGRAPHY

3.5.1 Land Use

As previously mentioned, the North Area is zoned as “M-2, Heavy Manufacturing” and the South Area is zoned as “W-3, Waterfront Heavy”. The “M-2, Heavy Manufacturing” classification of the City of Freeport Zoning Code (City of Freeport, 2009) allows for manufacturing and industrial activities. The “W-3, Waterfront Heavy” classification provides for port, harbor or marine related activities including the storage, transport, and handling and manufacturing of goods, materials, and cargoes related to marine activities. The North Area consists of undeveloped land, a former parking area, and the closed surface impoundments. The South Area was developed for industrial uses with improvements including multiple structures, a dry dock, two barge slips, a sand blasting area, and an AST farm.

As noted in Section 1.2.1, restrictive covenants limiting types of land uses, construction, and groundwater use have been filed for various parcels of the Site. Restrictive covenants prohibiting any land use other than commercial/industrial and prohibiting groundwater use have been filed for all parcels within both the North and South Areas. Additional restrictions requiring any building design to preclude indoor vapor intrusion have been filed for Lots 55, 56, and 57 in the North Area. A further restriction requiring EPA and TCEQ notification prior to any building construction has also been filed for Lots 55, 56, and 57.

Adjacent property to the north, west, and east of the North Area is currently unused and undeveloped. These areas are also zoned as “M-2, Heavy Manufacturing”. The adjacent property to the east of the South Area is occupied by an offshore oil field services operation and, as indicated on the historical aerial photographs in Appendix A, has been used for industrial purposes since at least 1995. The adjacent property to the west of the South Area is currently vacant and previously served as a commercial marina as detailed previously in Section 1.2.1. This property is zoned as “W-1, Waterfront Resort”, which “consists mainly of areas occupied by or suitable for harbor and marine resort related activities including the storage, transport and handling of goods and materials related to pleasure and charter boats as well as such commercial uses as may have a natural relation to such activities, uses, and facilities” (City of Freeport, 2009). The nearest residential areas to the Site are located south of Marlin Lane, approximately 300 feet to the west, and 1,000 feet to the east.

3.5.2 Demographics

The Site is located within the city limits of Freeport in southeast Brazoria County. The population of Brazoria County is approximately 242,000, with approximately 12,700 residents in Freeport according to the 2000 U.S. Census (USCB, 2009). The racial makeup of residents in Freeport is 61.6% white, 13.4% African American, with 52.0% of the population identifying themselves as Hispanic or Latino (of any race). The median income for households in 1999 was $30,245, with a per capita income for the city of approximately $12,426. Approximately 22.9% of the population was below the poverty line (USCB, 2009).

According to the Site Community Involvement Plan (CIP) prepared by US EPA Region 6 (EPA, 2005), there are 78 residents within 1 square mile of the Site, 17.9% of which are minority and 23.3% of which are economically stressed. Within a 50 square mile are around the Site, the population is 3,392, of which 33.4% are minority and 24.3% are economically stressed.

3.6 ECOLOGY

As described previously, the South Area includes approximately 20 acres of upland that were created from dredged material from the Intracoastal Waterway. Prior to construction of the Intracoastal Waterway, this area was most likely coastal wetlands. The North Area, excluding the capped impoundments, former parking area and associated access roads, is considered estuarine wetland (USFWS, 2008). The North Area consists of approximately five acres of upland, which supports a variety of herbaceous vegetation that is tolerant of drier soil conditions, and approximately 15 acres of wetlands. The ecological setting of the Intracoastal Waterway adjacent to the site, the upland terrestrial areas, and the wetland areas is summarized below. A more detailed ecological discussion is provided in the SLERA (PBW, 2010b) and BERA (URS, 2011).

3.6.1 Intracoastal Waterway

The Intracoastal Waterway supports barge traffic and other boating activities. The area near the Site is regularly dredged and, as noted by the USFWS, shoreline habitat is limited (USFWS, 2005). Reduced light penetration, periodic dredging, wave action from barge traffic, and higher than normal tidal energy prevent submerged vegetation from growing in the Intracoastal Waterway near the Site. The absence of attached vegetation, which provides food and shelter, decreases the number of invertebrate species that can utilize the habitat in this sub-tidal zone and, therefore, most of the epibenthic invertebrates that utilize the sub-tidal zone in the Intracoastal Waterway near the Site are migrants.

Because of the reduced tidal energy at the upper end of each of the barge slips, a small amount of intertidal emergent marsh has developed in these areas. Sand and silt have accumulated in the ends of the slips and supports small stands of gulf cordgrass (*Spartina alterniflora*). Sheetpile and concrete bulkheads protect the remainder of the shoreline. The bulkheads provide habitat for oysters (*Crassostrea virginica*), barnacles (*Balanus improvisus*), sea anemones (*Bunodosoma cavernata*), limpets and sponges.

Fishing has been known to occur on and near the Site. Red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), spotted seatrout (*Cynoscion nebulosus*), southern flounder (*Paralichthys lethostigma*) and other species are reportedly caught in the area (TPWD, 2009). As discussed in Section 2.3.3, red drum were not caught (using nets) as frequently as other species during the fish sampling conducted for the human health fish ingestion pathway risk assessment, presumably because of a lack of habitat and prey items near the Site. Recreational and commercial fishermen collect blue crabs (*Callinectes sapidus*) from waterways in the area. The Texas Department of State Health Services (TDSHS) has banned the collection of oysters from this area due to biological hazards and has issued a consumption advisory for king mackerel for the entire Gulf Coast due to mercury levels in the fish (TDSHS, 2005).

3.6.2 Upland Areas

Much of the South Area is covered with concrete pads and driveways. Because of the former industrial operations, the South Area contains very few areas of undisturbed terrestrial or upland habitat. Little resident wildlife has been observed at the South Area. As concluded in the BERA Problem Formulation Report (URS, 2010b), South Area soils do not represent a valuable ecological resource that warrants further evaluation in order to protect invertebrates such as earthworms.

The approximately five acres of terrestrial or upland habitat at the North Area was created during previous operations at the Site. The five acres have developed some vegetation because plants have grown in some areas of the oyster-shell covered parking lot and former surface impoundments cap.

3.6.3 Wetlands

Wetlands are the transitional zones between uplands and aquatic habitats and usually include elements of both. The wetlands at the Site are typical of irregularly flooded tidal marshes on the Texas Gulf Coast. The lower areas in the northern half of the property are dominated by obligate and facultative wetland vegetation such as saltwort (*Batis maritima*), sea-oxeye daisy (*Borrichia frutescens*), shoregrass (*Monanthocloe littoralis*), Carolina wolf berry (*Lycium caroliniaum*), spike sedge (*Eleocharis sp*.), saltgrass (*Distichlis spicata*), Gulf cordgrass (*Spartina spartinae*), and annual marsh elder (*Iva annua*), and glasswort (*Salicornia bigelovii*). Higher ground near the road supports facultative wetland vegetation such as eastern bacchari (*Baccharis halimifolia*), sumpweed (*Iva frutescens*), and wiregrass (*Spartina patens*). Near Marlin Avenue, there are several shallow depressions that apparently collect and hold enough freshwater to allow homogenous stands of saltmarsh bulrush (*Schoenoplectus robustus*) to develop.

The high marsh, or supra-tidal zone, is the driest part of the coastal marsh habitat and supports far fewer invertebrate species. Due to the irregularity of flooding in the high marsh, there are no filter feeding bivalves or worms. Rather, the worms, amphipods, and isopods that live in the high marsh sediment are detritivores, direct deposit feeders, or predators.

The North Area supports wildlife that would be common in a Texas coastal marsh. Fiddler crabs (*Uca rapax*) are likely the most abundant crustacean in the North Area. Other crustaceans found at the Site were fiddler crabs (*Uca panacea*) and hermit crabs (*Clibanarius vittatus*). The most common gastropod is the marsh periwinkle (*Littorina irrorata*). The Site is also used by a variety of shorebirds. Birds observed at the Site include the great blue heron (*Ardea herodias*), great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), green heron (*Butorides striatus*), white ibis (*Eudocimus albus*), glossy ibis (*Plegadis falcinellus*), and willet (*Catoptrophorus semipalmatus*). The Site provides suitable habitat for rails, sora, and gallinules and moorhens, and may also be used by a variety of small mammals, rodents, and reptiles.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

As noted previously, a phased site investigation approach involving the comparison of Site data to established PSVs and background concentrations was used to identify the nature and extent of contamination in each environmental medium investigated. Details of the specific Site investigation activities performed as part of that approach were provided in Section 2.0. Consistent with the suggested RI report format (Table 3-13 in EPA, 1988b), this section of the report presents the results and findings of the investigation activities, particularly as they pertain to documenting the nature and extent of contamination. It should be noted that all of the information presented in this section was previously submitted to EPA, as part of the NEDR (PBW, 2009), which was approved by EPA on April 29, 2009.

RI data are generally discussed by geographic area (e.g. Intracoastal Waterway, North Area, South Area) and by specific environmental media (e.g. soil, sediment, etc.) within those areas in the subsections below. Groundwater activities are discussed separately at the end of the section. The text of each section provides a discussion of extent evaluation screening criteria and background (where applicable) exceedances with supporting tables and figures demonstrating how the lateral and vertical (where appropriate) extent of COIs has been identified. The Site database, which includes all laboratory analytical data, is provided in electronic form (on DVD) in Appendix B of this report. Electronic copies of the analytical laboratory and data validation reports (grouped by media and then laboratory sample delivery group) are also provided in Appendix B.

4.2 DATA VALIDATION

Consistent with QAPP procedures, data validation was performed on 100% of the environmental samples. Analytical results presented in this section include the QAPP-specified RI data validation qualifiers, which are defined as follows:

none	No QC deficiencies noted.
J	The analyte is confirmed present, but the reported value is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

J+	The reported value is an estimated quantity, and the result may be biased high.
J-	The reported value is an estimated quantity, and the result may be biased low.
R	The data are not usable due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample.
U	Analyte was not detected above 5x (10x for common contaminants) the level in an associated blank.
UJ	Analyte not detected at or above the sample detection limit, but the reported limit is an estimated quantity. The associated numerical value is an approximate concentration that may be inaccurate or imprecise.
NJ	Analyte tentatively identified. Presence of the analyte is not confirmed and the reported value is an estimated quantity.

A data validation qualifier of J may be assigned solely because the analytical result was qualified by the laboratory as an estimated concentration between the sample detection limit and the sample quantitation limit. When an option exists to assign two different flags, the flag higher in the data quality hierarchy was assigned (R > UJ > U > NJ > J > J+ or J-).

The completeness, which is the percentage of valid measurements obtained, was calculated for each medium and compared to the goals established in the QAPP (90% on a sample level and 80% on an analyte level). The completeness goal on a sample level was met for all media. The completeness goal on an analyte level was met for all media, except the following:

- <u>Benzidine in Surface Water (77% completeness) and Groundwater (67% completeness)</u> – This analyte is known to be subject to oxidative losses during solvent concentration and to poor chromatographic behavior. Low completeness does not limit data usability since the analyte was not detected in any of the surface water or groundwater samples with a valid measurement.

- <u>Benzoic Acid in Surface Water (77% completeness) and Groundwater (59% completeness)</u> – This analyte is also known to exhibit poor (non-reproducible) chromatographic performance. Low completeness does not limit data usability since the analyte was not detected in any of the surface water or groundwater samples with a valid measurement.

- <u>2-Chloroethylvinylether in Surface Water (0% completeness) and Soils (34% completeness)</u> – This analyte is known to be a reactive compound that readily breaks down under acidic conditions such as in acid-preserved aqueous samples. It is also subject to hydrolysis catalyzed by acidic sites in clay soils and to biodegradation in soil. Low completeness does not limit data usability since the analyte was not detected in other media and is not historically associated with the Site.

- <u>Hexavalent Chromium in Sediments (32% completeness) and Soils (3% completeness)</u> – This analyte was inadvertently not measured by the laboratory for most of the Phase 1 sediment and soil samples. Low completeness does not limit data usability since total chromium, which includes any hexavalent chromium, was measured for all affected samples.

- Pyridine in Surface Water (68% completeness) – This analyte is known to be subject to poor performance at the temperatures for the gas chromatograph injection port specified in the analytical method. Low completeness does not limit data usability since the analyte was not detected in any of the surface water samples with a valid measurement.

4.3 INTRACOASTAL WATERWAY

4.3.1 Sediments

The nature and extent of contamination in Intracoastal Waterway sediments was investigated through the collection and analysis of samples from the 0 to 0.5 foot depth interval at 17 locations adjacent to the Site (Figure 8) and nine background locations (Figure 7). As noted previously, samples could not be collected from two additional Site locations (IWSE35 and IWSE36 on Figure 8) due to insufficient sediment thickness for an adequate sample.

In accordance with Work Plan provisions for evaluating the lateral extent of COIs in Intracoastal Waterway sediment near the Site, chemical concentrations in perimeter Site sediment samples were compared to PSVs and background data on an individual sample basis. PSVs listed in Table 21 of the Work Plan, as updated to reflect changes in human health or ecological toxicity values since preparation of the Work Plan, were used in these comparisons. Background values used for these comparisons were calculated from the Intracoastal Waterway background sediment sample data using the tolerance interval approach described in EPA's *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA, 2002). Only certain metals were detected at a sufficient frequency in the background sediment samples to warrant development of a background value. Calculation details for these background Intracoastal Waterway sediment values are provided in Appendix G. The PSVs and background values considered for evaluating the lateral extent of COIs in Intracoastal Waterway sediment are listed in Table 12. Consistent with Work Plan provisions, the extent evaluation comparison values listed in this table represent the higher of either the PSV or background value (where applicable) for each COI.

As shown in Table 13 and on Figure 43, one or more COIs (4,4'-DDT and certain PAHs, including some carcinogenic PAHs) were detected at concentrations exceeding their respective comparison values at five Site sediment sample locations. Approximately two-thirds of these exceedances have a "J" data qualifier indicating an estimated concentration, typically between the sample detection limit and the sample quantitation limit. All five exceedance locations were within or on the perimeter of the barge slip areas. The lateral extent of COIs in sediment at these locations is defined by location IWSE34 to the west, where 4,4'-DDT (the sole exceedance at location IWSE01) was not detected, locations IWSE35 and IWSE36 to the south, where as noted previously, a sufficient sediment thickness for sample collection was not present, and locations IWSE06, IWSE09, and IWSE10 to the east, where no exceedances were observed.

4.3.2 Surface Water

Intracoastal Waterway surface water was investigated through the collection and analysis of four composite samples adjacent to the Site (Figure 8) and four composite background samples (Figure 7). COI concentrations in these samples were compared to PSVs listed in Table 20 of the Work Plan, as updated to reflect changes in human health or ecological toxicity values since preparation of the Work Plan. Based on the absence of any COIs exceeding PSVs in Intracoastal Waterway surface water samples adjacent to the Site, background surface water values were not calculated for this comparison. Thus, the extent evaluation comparison values listed in Table 14 reflect the lowest updated PSVs from Table 20 of the Work Plan. It should be noted that aldrin and dissolved silver concentrations in samples from all four background sample locations (IWSW30 through IWSW33) exceeded their respective extent evaluation comparison values. Concentrations of 4,4'-dichlorodiphenyldichloroethane (DDD) and 4,4'-DDT in the sample from background location IWSW33 also exceeded their respective extent evaluation comparison values.

4.4 SOUTH AREA

4.4.1 South Area Soil Investigation

As described in Section 2.4.1, soil samples collected as part of this investigation program included: (1) Phase 1 samples from the 0 to 0.5 ft and 1 to 2 foot depth intervals from 85 grid-based locations; (2) Phase 2 samples from the 4 to 5 foot depth interval from 15 of these locations; and (3) Phase 2 samples from various depth intervals at seven locations on the adjacent former commercial marina parcel to the west (also referred to as "Lot 20") (Figure 9). Analytical data from these samples were used to evaluate the extent of contamination through a comparison to PSVs for soil as listed in Tables 15 or 16 of the Work Plan (depending on sample location), subject to a comparison to background concentrations, as determined from Site-specific background samples or Texas-specific background concentrations provided in 30 TAC 350.51(m). This evaluation included the following:

(1) Western Extent of Contamination – Phase 1 analytical data for the 0 to 0.5 foot and 1 to 2 foot depth interval samples from the westernmost grid column of the South Area sample grid (Grid Column A as shown on Figure 9) were initially used to evaluate the western extent of contamination at the Site. Based on this comparison, the locations and analyses for Phase 2 samples collected from Lot 20 were determined. The Lot 20 data were then used to evaluate the western extent of contamination overall.

(2) Eastern Extent of Contamination – Phase 1 analytical data for the 0 to 0.5 foot and 1 to 2 foot depth interval samples from the easternmost grid column of the South Area sample grid (Grid Column L as shown on Figure 9) were used to evaluate the eastern extent of contamination in the South Area.

(3) Vertical Extent of Contamination – Phase 1 analytical data for the 1 to 2 foot depth interval samples from all locations were initially used to evaluate the vertical extent of contamination at the Site. Based on this comparison, the locations and analyses for Phase 2 samples collected from the 4 to 5 foot depth interval were determined. These deeper samples were then used to evaluate the vertical extent of contamination.

The southern extent of potential soil contamination is defined by the Intracoastal Waterway since it bounds the physical extent of soil on the southern end of the South Area. The northern extent of potential soil contamination in the South Area is similarly defined by Marlin Avenue, whose construction occurred prior to industrial operations in the South Area, and the North Area of the Site, which primarily consists of wetland areas and the former surface impoundments.

As described in Section 2.6, site-specific background soil data were obtained from ten surface soil samples collected approximately 2,000 feet east of the Site near the east end of Marlin Avenue (Figure 1). These background samples were analyzed for pesticides, semivolatile organic compounds (SVOCs), and selected metals (antimony, arsenic, barium, chromium, copper, lead, lithium, manganese, mercury, molybdenum, and zinc). Pesticides, SVOCs, antimony and cadmium were not detected at sufficient frequencies in background soil samples to warrant the development of Site-specific background values for these COIs. Site-specific background values were developed for all other metals for which background soil samples were analyzed.

In order to evaluate the extent of contamination, COI concentrations in Phase 1 perimeter samples (both horizontal and vertical as encompassed by the three data sets described above) were compared to PSVs and background data on an individual sample basis. Consistent with the approach described previously for Intracoastal Waterway RI sediment samples, tolerance limits were calculated for the Site-specific background metal analytes, as proposed in GRG's September 11, 2007 letter and approved by EPA's October 30, 2007 letter. The original zinc background calculation described in the September 11, 2007 letter was based on the removal of the three highest zinc results from the background data set prior to the tolerance limit calculation. Following additional review of the data and discussion with EPA on June 17, 2008, it was agreed that the lower of these three results should be included in this tolerance limit calculation. The revised zinc calculation using these data, along with the previous calculations for other metals from the September 11, 2007 letter, is provided in Appendix H. These background values were used in the evaluation of the three perimeter soil sample data groups as described below.

Western Extent of Soil Contamination Evaluation

As noted above, the western extent of soil contamination in the South Area was evaluated based on analytical data for the 0 to 0.5 foot and 1 to 2 foot depth interval samples from the westernmost grid column of the South Area sample grid (Grid Column A on Figure 9). As shown in Table 15, the comparison values for each COI are the higher of its PSV or background value (where applicable). The PSVs listed in Table 15 are from Table 16 of the Work Plan, as updated to reflect changes in human health or ecological toxicity values since preparation of the Work Plan. The background values listed in Table 15 are the Texas-specific background concentrations provided in 30 TAC 350.51(m) and the Site-specific background values determined as described above and listed in Appendix H.

Detected soil concentrations in western perimeter samples (i.e., Grid Column A locations) that exceed the Table 15 comparison values are listed in Table 16 and are shown on Figure 44. Based on these data, samples were collected from seven locations from Lot 20, the former commercial marina parcel to the west of the Site. Several exceedances were noted in these Lot 20 samples ("Phase 2 samples" as listed in Table 16) and shown on Figure 44. A review of the Lot 20 and Grid Column A data suggests the presence of an off-site contaminant source in the vicinity of sample locations L20SB06 and L20SB07, where concentrations of several COIs (particularly lead and zinc) were significantly higher than concentrations observed in adjacent South Area samples.

As shown on Figure 44, location L20SB07 is at the edge of a dry dock facility associated with the former commercial marina. Regardless of the source of the exceedances at locations L20SB04 through L20SB07, the western extent of potential soil contamination is bound by the former commercial marina boat slip area to the west which is the physical extent of soil west of these samples. The benzo(a)pyrene (BaP) concentration in the 0 to 0.5 foot depth interval sample at L20SB01 is also believed to be associated with an off-site source since no BaP exceedances were observed in multiple depth samples from sample locations L20SB02 and L20SB03, which are between the South Area and L20SB01. The lead exceedance at L20SB01 (estimated concentration of 19 mg/kg) is only slightly above the Site-specific background lead value of 17.9 mg/kg and is also believed to be associated with an off-site source based on a lead concentration of 462 mg/kg in a nearby surface sample (L20SS04 shown on Figure 45) collected as part of the residential surface soil investigation described below. Based on this evaluation, it is concluded that the western extent of soil contamination in the South Area has been defined.

Eastern Extent of Soil Contamination Evaluation

The eastern extent of soil contamination in the South Area was evaluated based on analytical data for the 0 to 0.5 foot and 1 to 2 foot depth interval samples from the easternmost grid column of the South Area sample grid (Grid Column L on Figure 9). As proposed in GRG's September 11, 2007 letter and approved by EPA's October 30, 2007 letter, ecological PSVs were not considered for the eastern extent evaluation because the property east of the South Area is an operating industrial facility with no appreciable ecological habitat. Thus, the comparison values in Table 17, which include PSVs from Table 15 of the Work Plan with the ecological PSVs removed, were used for this evaluation. The comparison values for each COI in Table 17 are the higher of its PSV or background value (where applicable). No detected concentrations in the eastern perimeter samples (i.e., Grid Column L locations) exceeded the Table 17 comparison values. Based on this evaluation, it is concluded that the eastern extent of soil contamination in the South Area has been defined.

Vertical Extent of Soil Contamination Evaluation

The vertical extent of soil contamination in the South Area was evaluated based on Phase 1 analytical data for the 1 to 2 foot depth interval samples from all locations in the South Area. As described in GRG's September 11, 2007 letter and approved by EPA's October 30, 2007 letter, ecological PSVs were not considered for the vertical extent evaluation because Site soil conditions suggest that there is limited potential for significant biological activity below a depth of two feet and representative Site ecological receptors typically do not burrow below this depth. Based on these considerations, human health PSVs (as reflected in Table 17) were used (with background) for the vertical extent of soil contamination evaluation.

Table 18 lists the detected soil concentrations in the Phase 1 samples that exceed the Table 17 comparison values. Based on these data, deeper soil samples were collected from the 4 to 5 foot depth interval at 15 locations and analyzed as listed in Table 19. No comparison value exceedances were detected, thus the vertical extent of COIs in South Area soils is limited to depths less than 4 feet, except for a sample collected from a depth of 4.5 feet during the TCRA.

4.4.2 Residential Surface Soil Investigation

As described in Section 2.4.2, this investigation program included the collection of surface soil samples for chemical analysis from the 0 to 1 inch depth interval at 27 specified locations on off-site Lots 19 and 20 (see Figure 10 for sample locations). The analytical suite for these samples was determined through an evaluation of data for 0 to 1 inch and 0 to 0.5 foot depth interval samples from on-site Lots 21, 22 and 23 as detailed in the Work Plan (Site lot designations are shown on Figure 2). Based on this evaluation, which was detailed in GRG's August 20, 2007 letter to EPA (approved with modification on September 6, 2007 and resubmitted on September 21, 2007), the 27 surface soil samples collected from off-site Lots 19 and 20 were analyzed for lead.

Lead concentrations in the Lot 19/20 surface soil samples are listed in Table 20 and plotted on Figure 45. Consistent with the data evaluation approach described in GRG's August 20, 2007 letter to EPA, these data were compared to the lowest of the lead PSVs in Table 17 of the Work Plan that are associated with direct contact exposure pathways (i.e., those pathways involving potential soil contact by residential receptors). The lead PSVs for these pathways are the EPA Region 6 human health media-specific screening level for soil of 400 mg/kg, and the TCEQ $^{Tot}Soil_{Comb}$ Protective Concentration Level (PCL) of 500 mg/kg, which includes inhalation, ingestion and dermal pathways. Thus, a lead concentration of 400 mg/kg was used as the comparison value for assessing whether further surface soil investigation beyond Lots 19 and 20 was necessary.

The sole Lot 19/20 surface soil sample with a lead concentration greater than 400 mg/kg was sample L20SS04 (462 mg/kg). As shown on Figure 45, this sample was collected adjacent to a concrete slab (and the location of a former building) associated with former commercial marina operations on Lot 20 described previously. This lead concentration is believed to be indicative of a local source associated with the former marina rather than a source at the Gulfco site. As shown on Figure 45, lead concentrations in Lot 20 surface soil samples (0 to 1 inch depth interval) collected between L20SS04 and the Gulfco site (i.e., samples L20SS05 and L20SS06) were below or near the lead background concentration of 17.9 mg/kg, and thus far below the L20SS04 result or similarly elevated lead concentrations that would be expected if the Gulfco site were a source of elevated lead to this area. Regardless of the source of the lead concentration at L20SS04, the lead concentrations in surface soil samples between L20SS04 and Snapper Lane to the west (as indicated by the data for samples L19SS01, L19SS02, L19SS08, L19SS09, L19SS15, and L20SS01 as shown on Figure 45) were all far below the 400 mg/kg comparison value, thus precluding the need for further residential soil investigation sampling. Lead concentrations in the seven westernmost surface soil sample locations near Snapper Lane (samples L19SS01 through L19SS07 as shown on Figure 45) were all below or near the background lead concentration (17.9 mg/kg), further demonstrating the absence of impacts to soil in this area.

4.5 NORTH AREA

4.5.1 North Area Soil Investigation

As described in Section 2.5.2, the nature and extent of contamination in North Area soils was investigated through the collection of: (1) Phase 1 samples from the 0 to 0.5 ft and 1 to 2 foot depth intervals at 14 grid-based locations; (2) a Phase 2 sample from the 4 to 5 foot depth interval at one of these 14 locations (ND3SB04); (3) Phase 2 samples from the 0 to 0.5 foot and 1.5 to 2.0 foot depth intervals at locations SB-201, SB-202, and SB-203 where scrap metal was observed at the ground surface; and (4) Phase 2 samples from varying depths at locations SB-204, SB-205, and SB-206 in the area where subsurface debris (e.g., a section of rope) was observed in the auger cuttings from a monitoring well boring. Soil samples for laboratory analyses were collected from SB-204, SB-205, and SB-206 at depth intervals generally corresponding to one foot immediately above observed subsurface debris, one foot immediately below the debris, and within the approximate center of the observed debris layer, except at SB-205 where a sample was not collected below the debris as described below. North Area soil sample locations are shown on Figure 11.

Since the physical extent of soil in the North Area is bound by the surrounding wetland areas (where wetland sediment samples were collected and evaluated), the lateral extent of potential soil contamination in the North Area was effectively determined by the lateral extent of soil. The vertical extent of contamination in North Area soils was evaluated through a comparison of soil data to the extent evaluation comparison values listed in Table 17. Table 21 and Figure 46 list detected soil concentrations in the North Area soil samples that exceed the soil extent evaluation comparison values listed in Table 17. In most cases where an exceedance was noted, a deeper soil sample with no comparison value exceedances defined the vertical extent of contamination. At boring locations ND3SB04 and SB-206, exceedances were noted in the deepest sample collected (4 to 5 foot and 5 to 6 foot depth intervals, respectively); however, in accordance with Work Plan provisions that soil samples need not be collected from depths below either: (1) the water table; or (2) the surface soil depth at the sample location as defined in 30 TAC 350.4(a)(88) (i.e., five feet), deeper sampling was not performed.

At boring SB-205, debris was observed from approximately three to six feet bgs. Given the depth of the debris relative to the saturated zone (saturated conditions were observed at a depth of approximately 4 to 5 feet), it was decided (with EPA concurrence) to not attempt to collect a sample below the debris at this location. Thus, sampling was not performed below the 3 to 4 foot depth interval sample although iron and lead concentrations in this sample exceeded their respective comparison values (Table 21).

The laboratory was unable to analyze the 3 to 4 foot depth interval sample (the debris interval sample) at boring location SB-205 for organic analytes due to solidification of the sample extracts during the concentration step of the analyses. Such solidification is consistent with olfactory and visual indications of naphthalene in this sample at the time of collection. As indicated by the absence of naphthalene exceedances in nearby SB-204 and SB-206 samples (Table 21), and the lack of visual and olfactory indications of naphthalene observed during the drilling of those borings, the area containing naphthalene in buried debris or adjacent soils appears limited to the vicinity of SB-205.

Borings SB-201 through SB-203 were drilled at EPA's request to evaluate the possible presence of subsurface debris in this vicinity where scrap metal materials were present on the ground surface. As shown in Table 21, the only metals concentrations above their respective vertical extent comparison criteria in these borings were iron and lead in the 0 to 0.5 foot depth sample from SB-202. These metals were not present at concentrations greater than their respective vertical extent comparison values in the 1.5 to 2.0 foot depth sample from this location. BaP was reported above its vertical extent comparison value in the 1.5 to 2.0 foot sample from SB-203, but was not detected in the 0 to 0.5 foot sample at this location. Based on the SB-201 through SB-203 concentration data and visual observations from these borings, which did not indicate the presence of significant subsurface debris, no further investigation of this area was performed.

4.5.2 Wetlands Sediments Investigation

The nature and extent of contamination in wetland sediments was investigated through the collection of: (1) samples from the 0 to 0.5 foot depth interval at 17 Phase 1 locations; (2) samples from the 1 to 2 foot depth interval at 10 of these locations, where saturated conditions were not encountered at depths less than 2 feet; (3) samples from the 0 to 0.5 foot depth interval at 17 additional judgment-based locations; (4) samples from the 0 to 0.5 foot depth interval at ten perimeter locations; and (5) samples from the 0 to 0.5 foot depth interval at two other locations requested by EPA. These 46 wetland sediment sample locations are shown on Figure 12. Wetland sediment sample analytical data were used to evaluate the lateral extent of contamination through a comparison to sediment PSVs listed in Table 21 of the Work Plan, subject to a comparison to background concentrations. Given the similar composition and condition of the surface soils collected from within the approved background soil area to the wetland sediments in the North Area, the Site-specific background values determined from those soil samples, as described in Appendix H, were used to represent background wetland sediment concentrations for the purposes of evaluating the lateral extent of contamination. As shown in Table 22, the comparison value for each COI is the higher of its PSV or background value (where applicable). The PSVs listed in Table 22 are from Table 21 of the Work Plan, as updated to reflect changes in human health or ecological toxicity values since preparation of the Work Plan. The background values listed in Table 22 are the Site-specific background values determined as described above.

Detected COI concentrations in wetland sediment samples that exceed the Table 22 comparison values are listed in Table 23 and plotted on Figure 47. As shown on this figure, extent evaluation comparison values were not exceeded in any of the outermost wetland sediment samples. Therefore, it is concluded that the lateral extent of contamination in wetland sediment to the west, north and south and east has been identified. The physical extent of wetland sediments (and thus potential contamination in wetland sediments, as well) is bound by Marlin Avenue and South Area soils to the south.

4.5.3 Wetland Surface Water Investigation

As described in Section 2.5.4, the nature and extent of contamination in wetland surface water was investigated through the collection of samples at four locations shown on Figure 12. Detected COI concentrations in these four surface water samples (2WSW1, 2WSW2, 2WSW3, and 2WSW6) were evaluated relative to the surface water extent evaluation comparison values listed in Table 14. The concentrations listed in Table 24 exceeded their respective extent evaluation comparison values. These exceedances are also plotted on Figure 48.

As shown on Figure 48 and Table 24, wetland surface water comparison value exceedances were limited to acrolein, copper, mercury, and manganese. The lateral extent of the copper and manganese exceedances noted in Sample 2WSW6 is effectively bound by the extent of surface water within the small area of ponded water south of the former surface impoundments where this sample was collected. This area was completely dry in June 2008. The southern extent of copper and mercury in samples 2WSW1 and 2WSW2 north of the Site is defined by sample 2WSW3 where no exceedances were observed. The northern, western, and eastern extent of the acrolein, copper and mercury in sample 2WSW1 is effectively bound by the physical extent of perennial standing water in this area (i.e., standing water is not perennially present in these directions). Based on this conclusion, no further investigation of wetland surface water was performed.

4.5.4 Ponds Sediments Investigation

The nature and extent of contamination in pond sediments was investigated through the collection of samples from the 0 to 0.5 foot depth interval at five locations within the Fresh Water Pond and three locations within the Small Pond as shown on Figure 12. Detected chemical concentrations in these samples were evaluated relative to the sediment extent evaluation comparison values listed in Table 22. The concentrations listed in Table 25 exceeded their respective comparison values. These exceedances are also plotted on Figure 49. As shown thereon, all exceedances were associated with the Small Pond, where zinc concentrations in all three samples exceeded the comparison value and the 4,4'-DDT concentration in the southernmost sample exceeded the comparison value. The lateral extent of these sediment exceedances are bound by the limited physical extent of the pond.

4.5.5 Ponds Surface Water Investigation

The nature and extent of contamination in pond surface water was investigated through the collection of samples from three locations within the Fresh Water Pond and three locations within the Small Pond as shown on Figure 12. Detected chemical concentrations in these samples were evaluated relative to the surface water extent evaluation comparison values listed in Table 14. The concentrations listed in Table 26 exceeded their respective comparison values. As shown on Figure 50, the ponds surface water exceedances were limited to total arsenic (two Fresh Water Pond samples), total or dissolved thallium (all samples except for one location in the Fresh Water Pond), total and dissolved manganese (Small Pond samples), and dissolved silver (all samples). The lateral extents of these surface water exceedances are bound by the limited extents of the ponds.

4.6 GROUNDWATER

As discussed previously, the three uppermost water-bearing units at the Site, which are designated from shallowest to deepest, as Zone A, Zone B and Zone C, respectively, were evaluated as part of the Site groundwater investigation. Details regarding investigation methods and procedures were provided in Section 2.7. Water-bearing unit characteristics, including lithology, structure, hydraulic characteristics, and groundwater flow directions, were described in Section 3.4. The extent of contamination in each unit, as identified by Site investigation activities is described by unit below.

An evaluation of the possible presence of LNAPL and DNAPL in Site monitoring wells was performed as part of groundwater investigation activities using an interface probe and/or bailer. Visible NAPL was observed within the soil matrix at the base of Zone A in the soil cores for monitoring wells ND3MW02 and ND3MW29, and at the base of Zone B in the soil core for monitoring well NE3MW30B (see cross sections in Plates 2 and 3 and boring logs in Appendix C). Soil samples were collected from these cores at ND3MW29 and NE3MW30 (Samples

SBMW29-01 and SBMW30-1) respectively and analyzed for VOCs, SVOCs, and pesticides. COIs detected in these soil samples are listed in Table 27. As shown on Table 27, 1,1,1-TCA, PCE and TCE were the COIs present at the highest concentrations in these soil samples and thus appear to be among the primary components of the NAPL observed in the cores. Monitoring well evaluations (i.e., NAPL thickness measurements using an interface probe and/or bailer) did not encounter NAPL in these or any other Site monitoring wells. Similarly, no NAPL sheens were observed either.

4.6.1 Zone A

The extent of contamination in Zone A was evaluated through the collection and analysis of samples from 24 monitoring wells and 8 temporary piezometers. Samples from the initial 17 Zone A monitoring wells (MW01 through MW17) and 8 piezometers (PZ01 through PZ08) were analyzed for the complete suite of groundwater analytes as specified in the Work Plan, the FSP and the QAPP. The analytical data from these samples were used to evaluate the extent of groundwater contamination at the Site, and assess the need for additional groundwater investigation activities. This evaluation entailed a comparison to PSVs on an individual sample basis. The PSVs listed in Table 18 of the Work Plan, which consider TCEQ PCLs for Class 3 groundwater (i.e., groundwater from low-yielding units or with TDS concentrations greater than 10,000 mg/L), PCLs for volatilization of COIs from groundwater to ambient air, and TCEQ ecological benchmark values for surface water (conservatively assuming groundwater discharge to surface water) were used for this evaluation. The extent evaluation comparison values listed in Table 28 reflect the PSVs from Table 18 of the Work Plan as updated to reflect changes in human health or ecological toxicity values since preparation of the Work Plan.

Detected COI concentrations in Zone A groundwater samples that exceeded Table 28 extent evaluation comparison values are listed in Table 29. As indicated therein, exceedances were predominantly for VOCs, specifically the following ten compounds:

- 1,1,1-TCA;
- 1,1-dichloroethene (1,1-DCE);
- 1,2,3-trichloropropane (1,2,3-TCP);
- 1,2-dichloroethane (1,2-DCA);
- benzene;

- cis-1,2-DCE;
- methylene chloride;
- PCE;
- TCE; and
- vinyl chloride (VC).

For several of these compounds, groundwater concentrations in a few wells exceeded 1% of the compound's solubility limit, which is often used as an indicator for the possible presence of NAPL. This is primarily true for samples from monitoring wells ND3MW02 and ND3MW29, where, as noted previously, visible indications of NAPL were observed within the soil matrix in soil core samples. At ND3MW29, for example, the maximum 1,1,1-TCA groundwater concentration of 234 mg/L is approximately 5% of its solubility (4,400 mg/L), the maximum PCE groundwater concentration of 12.9 mg/L is approximately 9% of its solubility (150 mg/L), and the maximum TCE concentration of 135 mg/L is approximately 12% of its solubility (1,100 mg/L)(solubility values are from EPA, 1992).

Isoconcentration maps for the ten primary groundwater COIs listed above (Figures 51 through 60) were used to project the lateral extent of contamination within Zone A. Multiple samples were collected from some Zone A monitoring wells as indicated in Table 29; in those cases, the COI concentration data for the most recent sample from that well were plotted on Figures 51 through 60.

The outermost contour lines on Figures 51 through 60 reflect the extent evaluation comparison value for the specific VOC shown on each of the figures. As shown on the figures, the concentration distribution is fairly consistent between VOCs, with highest concentrations typically observed near the southern corner of the former surface impoundments. The lateral extent of contamination, indicated by the outermost contour line, was limited to the North Area, in all cases except for benzene and vinyl chloride where exceedances were noted in the sole sample collected from temporary piezometer ND1PZ03 located immediately north of the Site property boundary. Typically the lateral extent of VOCs was limited to the southern half of the former surface impoundments area and a similarly sized area immediately to the south.

Several SVOCs (primarily anthracene, naphthalene, phenanthrene, pyrene) and pesticides (primarily endosulfan II, endosulfan sulfate, 4,4'-DDE, Dieldrin, gamma-BHC, and heptachlor epoxide) were occasionally detected in Zone A groundwater samples at concentrations exceeding extent evaluation comparison values (Table 29). These exceedances were either: (1) not confirmed by a second sample collected at that location (e.g., the endosulfan sulfate and heptachlor epoxide exceedances in the August 2, 2006 sample from SJ1MW15 were not confirmed in a subsequent sample collected from this well on June 4, 2007); (2) not confirmed by a sample from a monitoring well subsequently installed adjacent to a temporary piezometer location (e.g., the endosulfan II exceedance at NB4PZ01 was not confirmed by the sample from monitoring well NB4MW18); or (3) bounded by samples from downgradient monitoring wells that did not show exceedances of that specific COI (e.g., gamma-BHC exceedances at SF5MW10 were bounded by samples from SE6MW09, SF6MW11, and SG2MW13).

As indicated in Table 29, chromium, nickel, and silver concentrations exceeded extent evaluation comparison values in a number of Zone A groundwater samples. In all cases, these concentrations exceeded TCEQ ecological benchmark values for surface water ecological surface water criteria, but were far below TCEQ Class 3 groundwater PCLs (Table 28). As such, these exceedances are solely attributable to the conservative assumption of direct and undiluted discharge of Site groundwater to surface water. Furthermore, the ecological benchmark values are intended to apply to dissolved concentrations in surface water rather than the total concentrations represented by the groundwater data. Considering the presence of a significant amount of fine-grained material in Zone A soils (i.e., silt or clay), it is highly unlikely that the chromium, silver, and nickel concentrations detected in groundwater samples reflect actual dissolved concentrations in groundwater that could be theoretically discharged to surface water. Even if the observed total chromium, nickel, and silver concentrations did reflect dissolved concentrations discharging to surface water, the resultant mass flux would be extremely low and would be readily diluted at the point of discharge. Thus, these ecological benchmarks for dissolved metals concentrations in surface water are not considered applicable to total metals concentrations in groundwater samples. As a result, the chromium, nickel and silver groundwater exceedances relative to ecological surface water criteria data were not used to define the lateral extent of contamination in Zone A.

4.6.2 Zone B

The extent of contamination in Zone B was evaluated through the collection and analysis of samples from five monitoring wells. Monitoring wells were not installed in two additional proposed Zone B soil borings (NC2B23B and OB26B) because Zone B was not present at those locations. COI concentrations in the five Zone B groundwater samples are listed in Table 30. Consistent with extent evaluation procedures specified in the Work Plan for groundwater-bearing units that are unlikely to discharge to surface water or sediments, the extent evaluation comparison values listed for Zone B in Table 30 do not consider ecological PSVs. As indicated in this table, the only detected concentrations exceeding extent evaluation comparison values were seven VOCs in the sample collected from well NE3MW30B, southeast of the former surface impoundments. Groundwater concentrations of several COIs in well NE3MW30B exceeded the 1% compound solubility limit threshold indicating the possible presence of NAPL. For example, the 1,1,1-TCA groundwater concentration of 64 mg/L is approximately 1.5% of its solubility (4,400 mg/L), the PCE groundwater concentration of 23.8 mg/L is approximately 16% of its solubility (150 mg/L), and the TCE concentration of 170 mg/L is approximately 15% of its solubility (1,100 mg/L)(solubility values are from EPA, 1992). These groundwater data support the observation of visible NAPL within the soil matrix at the base of Zone B in the soil core for NE3MW30B. The lateral extent of contamination in Zone B is limited to NE3MW30B since there were no exceedances in samples from the other Zone B monitoring wells.

4.6.3 <u>Zone C</u>

The extent of contamination in Zone C was evaluated through the collection and analysis of samples from one groundwater monitoring well (NE4MW32C) and five CPT piezometers. COI concentrations in the groundwater samples collected from this well and these piezometers are listed in Table 31. As for Zone B, the extent evaluation comparison values listed for Zone C in Table 31 do not consider ecological PSVs. As indicated in this table, the only concentrations exceeding extent evaluation comparison values were 1,2,3-TCP; PCE; and TCE in the initial sample collected from monitoring well NE4MW32C, and 1,2,3-TCP in a second sample collected from this well. No exceedances were noted in two subsequent samples collected from NE4MW32C, nor were any exceedances indicated in samples from any of the five CPT piezometers. Based on the absence of any exceedances in the five Zone C piezometers, and the lack of confirmed exceedances in NE4MW32C, it is concluded that the vertical extent of contamination in Site groundwater has been defined.

5.0 CONTAMINANT FATE AND TRANSPORT

5.1 INTRODUCTION

Potential routes of contaminant migration were evaluated through Preliminary Conceptual Site Models (CSMs), first developed in the Work Plan. These CSMs identified potentially complete exposure pathways at the Site for human or ecological receptors. Separate human health CSMs were developed for the South Area and the North Area, and separate ecological CSMs were developed for terrestrial and aquatic/estuarine ecosystem receptors. These CSMs were updated in the BHHRA, and SLERA and further refined in the BERA to consider the biological data collected for the BERA. The updated CSMs, as shown on Figures 61 through 64, include consideration of contaminant release mechanisms, environmental fate and transport characteristics of those contaminants, potential receptors and potential exposure routes/pathways to those receptors. Consistent with the suggested RI report format (Table 3-13 in EPA, 1988b), this section of the RI report describes the fate and transport characteristics of COIs at the Site, starting first with a discussion of potential routes of migration as evaluated in the human health and ecological CSMs (Section 5.2), and then followed by consideration of contaminant persistence and migration characteristics (Section 5.3).

5.2 POTENTIAL ROUTES OF MIGRATION

5.2.1 <u>Human Health Pathways</u>

In the South Area, potential chemicals of concern (PCOCs) could have been released from historical PSAs to the soil and then migrated to groundwater via leaching through the soil column, and to surface water in the Intracoastal Waterway via overland surface runoff. It should be noted, however, that there is very little topographic slope at the Site and indications of soil erosion are not apparent. Once in surface water, some PCOCs would tend to stay dissolved in the water whereas others would tend to partition to sediment. Volatilization and dust generation could have caused some PCOCs in soil to migrate within the Site or off-site. Exposure to on-site receptors could also potentially occur through direct contact with the soil. Based on PCOC (i.e., lead) data for surface soil samples collected on Lots 19 and 20 directly west of the Site (see Section 4.4.2) and the evaluation conducted in the BHHRA, it does not appear that significant entrainment and subsequent deposition of soil particles through dust generation and transport has occurred at the Site or at off-site locations. Once in groundwater, VOCs could potentially migrate with the groundwater and/or volatilize through the soil pore space and be emitted into outdoor or indoor air.

At the North Area, PCOCs were potentially released from historical PSAs to the soil and/or may have migrated to groundwater. PCOCs may have also migrated from soil to surface water and sediments in the nearby wetlands area via overland surface runoff. Like the South Area, the minimal topographic slope in the North Area likely has not resulted in significant overland surface runoff. Fugitive dust generation was considered a potentially significant transport pathway for PCOC migration on-site and evaluated quantitatively in the BHHRA for the on-site receptors although this pathway was eliminated during the screening process for the off-site residential receptor. Once in groundwater, VOCs may migrate with the groundwater and/or volatilize through the soil pore space and be emitted into outdoor or indoor air.

As shown on Figure 61 and 62, complete South Area and North Area pathways, respectively, were primarily associated with on-site exposure to soil and ambient/indoor air; and off-site exposure to surface water, sediments, or ambient air. The potential risks associated with these complete pathways were quantified in the BHHRA, as summarized in Section 6.0.

5.2.2 Ecological Pathways

Potential routes of migration for ecological pathways in the terrestrial and aquatic ecosystems are depicted in Figures 63 and 64, respectively. Based on Site data, potential ecological exposure pathways were identified as either incomplete, not viable, potentially complete, or posing no unacceptable risk based on the results of the SLERA. Potentially complete ecological exposure pathways are indicated with a solid square in the far right columns of Figures 63 and 64. Potential terrestrial ecosystem receptors (Figure 63) include vegetation, detritivores and invertebrates, herbivores, omnivores, and carnivores. Potentially complete terrestrial exposure pathways involve contaminant releases from PSAs to soil, potential suspension/deposition, or erosion/runoff, followed by: (1) direct contact/soil ingestion by all potential receptors; (2) gill uptake by potential detritivore and invertebrate receptors; and (3) food ingestion by all potential non-vegetation receptors. The potential risks associated with the complete pathways were quantified in the SLERA, and further evaluated in the BERA as summarized in Section 7.0.

Potential aquatic ecosystem receptors (Figure 64) include benthos/epibenthos, zooplankton, fish/shellfish, and vertebrate carnivores. Potentially complete aquatic exposure pathways involve: (1) direct contact by all receptors; (2) gill uptake by applicable receptors; (3) food ingestion by all non-vegetation receptors; and (4) media (e.g., surface water, sediment) by applicable receptors. Again the potential risks associated with these pathways were quantified in the SLERA and further evaluated in the BERA.

5.3 CONTAMINANT PERISTENCE AND MIGRATION

As noted in the human health and ecological CSMs described above, potential routes of migration for Site PCOCs occur in the primary transport media of air, surface water/sediment (including runoff during storm events), and groundwater. Contaminant migration routes in these media are often interrelated. For example, dust from the Site ground surface may be transported via air and deposited in an adjacent area. From this deposition site, soil particles may be mobilized in the dissolved and/or solid phases by runoff during storm events, or remobilized by wind. Soil particles in runoff may then accumulate in surface water sediments. In addition, dissolution/ desorption may release PCOCs from sediments to surface water, or from infiltrating runoff to groundwater.

The physical and chemical characteristics of PCOCs and their potential transport media affect the degree of contaminant persistence and rate of migration within that media. Physical characteristics include parameters such as grain size and moisture content for surface soil particles or residual grit from Site sand-blasting areas. Chemical characteristics include parameters such as soil/water distribution coefficient, adsorption potential and degradation characteristics. These chemical characteristics are specific to each chemical present, and may also be affected by the physical characteristics of the media in which the chemical is present. For air migration pathways, physical characteristics are important because mobilization of soil particles by wind is often a dominant mechanism for potential air transport of contaminants. Chemical characteristics, such as the volatility of a particular PCOC (as reflected by its Henry's Law constant) can also be very important for air pathways. In surface water, physical and chemical characteristics are both important because transport may occur in solution or in association with suspended sediment. Dissolved-phase transport is the dominant contaminant migration mechanism in groundwater; therefore, chemical characteristics are often most important with respect to that medium. A more detailed discussion of contaminant characteristics affecting persistence and migration is provided by media in the paragraphs below.

5.3.1 Air Transport Pathways

A possible mode for airborne contaminant transport at the Site is entrainment of PCOC-containing particles in wind. This pathway is a function of particle size, chemical concentrations, moisture content, degree of vegetative cover, surface roughness, size and topography of the source area, and meteorological conditions (wind velocity, wind direction, wind duration, precipitation, and temperature). Movement of airborne contaminants occurs when wind speeds are high enough to dislodge particles; higher wind velocities are required to dislodge particles than are necessary to maintain suspension.

Potential airborne contaminants at the Site consist predominantly of particles since volatile PCOCs were generally not detected above screening levels in near surface (1 to 2 foot depth interval) soil samples (as specified in the Work Plan, surface soil samples were not analyzed for VOCs) and generally would not be expected to persist in surface soils. Thus, potential contaminant transport via air is predominantly in the solid phase. The physical characteristics of the particles govern the potential for airborne migration. The mass of a contaminant transported from a given PSA is also dependent on the contaminant concentrations in surface soil particles.

In general, only fine-grained particles are susceptible to transport in air. PCOCs associated with the scrap metal present in surface fill soils in the South Area and some parts of the North Area would generally not be transported via the air pathway due to the size and density of these materials. Similarly, the predominantly vegetated and moist surface soils/sediments in the North Area are not generally conducive to dust generation and particle transport. As discussed in Section 3.2, the predominant wind direction in the Houston region is from the southeast and south. Thus, potential contaminant migration via the air transport pathway would generally be toward the north and northwest from Site PSAs. Surface samples in the North Area (Figure 47) generally downwind from the South Area PSAs most likely to contribute metals to surface particles, such as the sand blasting areas (Figure 5), typically did not indicate elevated concentrations of metals above screening levels, and thus airborne transport from these areas appears limited. Similarly, as discussed in the context of the South Area human health CSM above, lead concentrations in surface soil samples collected on Lots 19 and 20 southwest of the

Site were relatively low and not indicative of significant air transport of contaminants from Site PSAs via entrainment and subsequent deposition of particles.

5.3.2 Surface Water/Sediment Transport Pathways

The primary surface water/sediment pathways for PCOC migration from historical Site PSAs are: (1) erosion/overland flow to wetland areas north and east of the Site from the North Area due to rainfall runoff and storm/tide surge; and (2) erosion/overland flow to the Intracoastal Waterway from the South Area as a result of rainfall runoff and extreme storm surge/tidal flooding events.

Overland flow during runoff events occurs in the direction of topographic slope. Overland flow during runoff events occurs if soils are fully saturated and/or precipitation rates are greater than infiltration rates, and thus this type of flow is usually associated with significant rainfall events. Due to the minimal slope at the Site, overland flow during more routine rainfall events is generally low, with runoff generally ponding in many areas of the Site. Extreme storm events, such as Hurricane Ike (see Section 3.2), can inundate the Site, resulting in overland flow during both storm surge onset and recession. During less extreme storm surge events or unusually high tides, tidal flow to wetland areas on and adjacent to the Site occurs from Oyster Creek northeast of the Site (Figure 1). However, as described in Section 3.3.2, more typically the wetland areas are not hydrologically contiguous with Oyster Creek.

Potential contaminant migration in surface water runoff can occur as both sediment load and dissolved load. Therefore, both the physical and chemical characteristics of the contaminants are important with respect to surface-water/sediment transport. The low topographic slope of the Site and adjacent areas is not conducive to high runoff velocities or high sediment loads. Consequently, surface soil particles would not be expected to be readily transported in the solid phase. Additionally, the vegetative cover in the North Area serves to reduce soil erosion and resulting sediment load transport with surface water in these areas. Dissolved loads associated with surface runoff from the North Area would likewise be expected to be generally low due to the absence of exposed PSAs, the low PCOC concentrations in North Area surface soils/sediments (Figures 46 and 47), and the relatively low solubilities of those PCOCs that are present (primarily, pesticides, PAHs, and/or metals). Although these classes of PCOCs are relatively persistent, the lack of contaminant migration within the wetland areas north of the Site, as indicated by the limited extent of PCOCs in wetland sediments beyond the Site area (Figure

47), supports the expectation of low sediment and dissolved load transport of PCOCs within the North Area.

Within the South Area, some PSAs, such as the sand blasting area, are exposed and PCOCs are present above screening levels at the ground surface. Exposed soils (primarily fill material) and indications of surface soil erosion are present within this area. Local areas of soil erosion and subsequent sediment deposition are apparent at the northern ends of the barge slips in Lots 21 and 22 (Figure 2). The PAHs detected in sediment samples from the end of the barge slips, particularly sample IWSE03 (Figure 43), compared to the PAHs detected in nearby surface soil samples, for example sample SA3SB17 (Figure 44), support the inference of surface soil erosion into the ends of the barge slips. However, the general absence of PAHs or other PCOCs in other areas of the barge slips toward the Intracoastal Waterway suggests limited migration of PCOC-containing sediments.

5.3.3 Groundwater Transport Pathways

As discussed in Section 4.6, groundwater in Zones A and B within the North Area near the former surface impoundments contains elevated concentrations of a number VOCs, including 1,1,1-TCA; 1,1-DCE; 1,2,3-TCP;1,2-DCA; benzene; cis-1,2-DCE; methylene chloride; PCE; TCE; and VC. For the purposes of this discussion, these VOCs are collectively referred to as the primary groundwater COIs. In addition to dissolved phase concentrations of these COIs, visible NAPL was observed within the soil matrix at the base of Zone A in the soil cores for monitoring wells ND3MW02 and ND3MW29, and at the base of Zone B in the soil core for monitoring well NE3MW30B, although NAPL has not been observed in these or any other Site monitoring wells. Soil samples from the cores at ND3MW29 and NE3MW30 contained many of these same primary groundwater COIs along with other compounds, including PAHs. The former surface impoundments are believed to be the source of the NAPL and dissolved primary groundwater COI concentrations. As described in Section 1.2.2, approximately 100 cubic yards of sludge within the impoundments that reportedly could not be excavated during impoundment closure in 1982 was solidified with soil and left in place (Guevara, 1989).

The groundwater pathway for potential transport of primary groundwater COIs or other PCOCs is lateral migration within Zones A and B and vertical migration, possibly as NAPL in very localized areas, or in dissolved form from Zone A to Zone B in areas where the Unit II clay separating Zone A and Zone B pinches out or is of minimal thickness. Vertical migration to deeper water-bearing zones below Zone B is effectively precluded by the thick, low vertical hydraulic conductivity (7 x 10^{-9} cm/sec) Unit III clay layer below Zone B (see Section 4.6).

Partitioning of organic COIs from NAPL into solution is a predominant issue regarding sourcing of COIs to groundwater pathways. Other possible mechanisms for potential groundwater impacts include leaching from residual sludges within the surface impoundments. Within the saturated zone, contaminant transport occurs primarily in the dissolved phase. The persistence of COIs in groundwater is affected by a number of naturally occurring physical, chemical and biological processes, such as biodegradation, dispersion, dilution, adsorption, and volatilization. As noted above, the primary groundwater COIs consist of benzene and multiple chlorinated aliphatic hydrocarbons (CAHs). All of these COIs degrade through natural biological processes. Benzene and other petroleum hydrocarbons have long been demonstrated to degrade under both aerobic and anaerobic conditions in the subsurface (Wiedemeier, et. al., 1999). CAHs have been shown to degrade under anaerobic conditions via multiple pathways, including reductive chlorination and methanogenesis (Vogel et. al., 1987; McCarty and Wilson, 1992; Vogel and McCarty, 1987).

EPA's technical protocol for evaluating the biodegradation of chlorinated solvents (EPA, 1998) bases biodegradation demonstrations on three main lines of evidence: (1) primary lines of evidence consisting of historical groundwater data that show a stable or decreasing trend in contaminant concentrations over time and/or distance away from the contaminant source; (2) secondary lines of evidence consisting of geochemical indicator data that indirectly show conditions conducive to the degradation processes of interest are present; and (3) tertiary lines of evidence consisting of laboratory or field microcosm studies that demonstrate these processes are occurring. Typically the primary and secondary lines of evidence are considered sufficient to demonstrate contaminant degradation at a site. The presence of degradation daughter products, such as cis-1,2-DCE and VC for PCE and TCE, is also considered an important line of evidence in these demonstrations. Geochemical indicators used for secondary lines of evidence include DO concentrations, ORP, ferrous iron concentrations, and others.

The technical protocol (EPA, 1998) incorporates these lines of evidence into a numerical weighting table as a means of preliminary screening for anaerobic biodegradation processes. The National Research Council (2000) and others (e.g., Nyer, et. al., 1998; Wilson, 2002) have criticized the use of such quantitative scoring systems, but have endorsed the qualitative use of multiple lines of evidence to evaluate the potential occurrence and significance of biodegradation processes. These lines of evidence generally include evaluations of: (1) whether the overall contaminant plume is stable or shrinking; (2) whether degradation of the primary contaminants, as evidenced by the presence of biodegradation daughter products, is occurring; and (3) whether the geochemical conditions in the subsurface are favorable for such biodegradation processes. Evaluations of these lines of evidence as applied to Zone A groundwater in the vicinity of the former surface impoundments at the Gulfco site are presented below.

Contaminant Plume Stability

The stability of dissolved phase plumes for the primary groundwater COIs in Zone A was evaluated through plots of the lateral extents of these ten VOCs for three groundwater sampling periods between July 2006 and June 2008 (Figures 65 through 74). In these figures, the lateral extent of each COI was defined by the concentration contour corresponding to its respective Zone A extent evaluation comparison value from Table 28. The lateral extent of a COI based on samples collected during the period between July 2006 and June 2007 is shown in blue on these figures. These samples correspond to the initial sample collected from a well, or the sole sample collected from a temporary piezometer, and thus vary by the date the well/piezometer was installed. The lateral extent of a COI based on samples collected in November 2007 (the second sampling of each well, as applicable) is shown in green on these figures, and the lateral extent based on samples collected in June 2008 (the third sampling of each well, as applicable) is shown in red. For most of the ten primary groundwater COIs, the overall plume area for the third sampling event was similar or, in some cases such as methylene chloride, significantly smaller than the overall plume area for the initial sampling event. Sections of the projected southern boundaries of the plume areas for 1,1,1-TCA (Figure 65), cis-1,2-DCE (Figure 70), PCE (Figure 72), and TCE (Figure 73) show some limited expansion between the three sampling events. This indication is primarily due to concentration increases of those COIs in samples from well ND3MW02. Similar increasing concentrations of 1,1,1-TCA, cis-1,2-DCE, PCE, and TCE were also observed in groundwater samples from ND3MW29, located at the southwestern corner of the former surface impoundments. As discussed in Section 4.6, visible indications of NAPL were observed in the soil cores from the borings for wells ND3MW02 and ND3MW29 at depths within the screened intervals of those two wells. As shown on Table 27, 1,1,1-TCA, PCE and TCE were the COIs present at the highest concentrations in soil samples from those core intervals and thus those COIs appear to be among the primary components of the NAPL observed in the cores (as discussed below cis-1,2-DCE is a degradation product of TCE). The dissolution of residual NAPL containing 1,1,1-TCA, PCE and TCE within the local screened areas of ND3MW02 and ND3MW29 is a likely explanation for why concentrations of those COIs (and the degradation product cis-1,2-DCE) in samples collected from those wells were not observed to decrease over time as was observed in most of the other monitoring wells in the vicinity. Thus, despite a few exceptions for some COIs in the local areas around ND2MW29 and ND3MW02 in the plume interior where NAPL was observed in the soil core, the overall time-series plume area plots for the primary groundwater COIs as shown in Figures 65 through 74 clearly exhibit generally stable or declining trends.

As discussed in Section 3.4.5, the Zone A potentiometric gradient has typically been relatively flat with local variability indicated at individual well/piezometer locations. A groundwater divide was often observed within the plume areas, typically south of the former surface impoundments (Figures 27 through 32). The groundwater flow direction was usually toward the west or northwest in the area north of the divide, and usually toward the south or southwest in the area south of the divide. For several of the primary groundwater COIs (e.g., 1,1,1-TCA as shown in Figure 65), some very limited expansion of the southern plume boundary toward the south or southeast may be inferred; however, a contraction or reduction in the northern plume boundary, which would also be in an apparent downgradient direction from the center of the plume, is indicated.

Presence of Biodegradation Daughter Products

As noted above, the presence of degradation daughter products is one line of evidence for contaminant degradation. In fact, many experts consider the accumulation of these daughter products as the most convincing evidence of degradation processes (Wilson, 2002). Reductive dechlorination is a primary mechanism for biodegradation of CAHs under anaerobic conditions. This process involves the release of a chlorine ion (Cl^-) by the parent CAH molecule and the acceptance of two electrons from an electron donor. In the case of PCE, reductive dechlorination produces TCE, which can further be reduced to cis-1,2-DCE (or less frequently trans-1,2-DCE or 1,1-DCE), then vinyl chloride and ultimately ethene. According to EPA, 1998, if more than 80% of DCE is present as the cis-1,2-DCE isomer, then this isomer is likely present as a degradation daughter product. Depending on site conditions, some of these chlorinated ethene transformations may not always occur, or may occur at significantly different rates resulting in the accumulation of daughter products, particularly cis-1,2-DCE and vinyl chloride (EPA, 1998). Other chlorinated ethene transformations can involve conversion of 1,1-DCE to VC under methanogenic conditions (Vogel and McCarty, 1987).

Reductive dechlorination involving other primary groundwater COIs at the Site include transformations of chlorinated ethanes, such as 1,1,1-TCA to 1,1-DCA, and then chloroethane. Transformation of TCA can also occur through chemical reactions, resulting in the production of 1,1-DCE (Vogel and McCarty, 1987). Reductive dechlorination has also been demonstrated for chlorinated methanes (i.e., transformation of carbon tetrachloride to chloroform to methylene chloride to chloromethane) (NRC, 2000) and other chlorinated alkanes, such as 1,2,3-TCP (Yan et. al., 2008).

In order to assess whether potential daughter products may be present in Zone A groundwater as a result of degradation processes, rather than due to their use and/or disposal at the Site, a review of available chemical handling information for historical Gulfco operations was performed. Fish's air permit exemption application (Fish, 1982) indicated that barge cargos handled at the Site contained a number of petroleum and chemical constituents, including benzene, methylene chloride, PCE and vinyl chloride. A search of Hercules' Job File records of barge cleaning services and the chemicals transported on those barges (Wittenbrink, 2009) listed benzene, PCE, TCE, 1,1,1-TCA, and 1,2-DCA among the chemicals transported in barges delivered to the Site for cleaning. In addition, benzene, PCE, TCE, vinyl chloride, and 1,2-DCA, along with methylene chloride, were among those chemicals detected in one or more total or toxicity characteristic leaching procedure (TCLP) samples from the AST Tank Farm tanks (PBW, 2007a).

Based on the above chemical handling information and the above evaluation of degradation mechanisms, the following explanations for the presence of the ten primary groundwater COIs were developed:

- 1,1,1-TCA – source material – present in barges delivered to Site;
- 1,1-DCE – inconclusive – common industrial chemical, but not on list of chemicals delivered to the Site, may also be present as daughter product of TCE or reaction product of TCA;
- 1,2,3-TCP – source material – industrial solvent, but not on list of chemicals delivered to the Site, not known as common transformation daughter product;
- 1,2-DCA - source material – present in barges delivered to Site and in tank content samples;

- benzene - source material – present in barges delivered to Site and in tank content samples;
- cis-1,2-DCE – likely daughter product – not on list of chemicals delivered to the Site, inferred to be daughter product of TCE as it occurs as the predominant (>80%) DCE isomer in several Site groundwater samples (e.g., NC2MW01, ND3MW02);
- methylene chloride - source material – present in barges delivered to Site and tank content samples;
- PCE – source material - present in barges delivered to Site and in tank content samples;
- TCE - source material - present in barges delivered to Site and in tank content samples, may also be present as degradation product of PCE; and
- VC – source material and daughter product - present in barges delivered to Site and tank content samples, but also likely present due to DCE degradation.

Consistent with the above explanations, the potential for reductive dechlorination of chlorinated ethenes was further evaluated through a comparison of the molar ratios of PCE, TCE, cis-1,2-DCE, and VC in Zone A groundwater samples. Based on the interpretation of cis-1,2-DCE as a likely degradation daughter product, the accumulation of this compound in Zone A groundwater, particularly in wells ND2MW01 and ND3MW02, is an indication of reductive dechlorination. Zone A chlorinated ethene concentrations, their corresponding molar concentrations, and the resulting mole fractions of these individual compounds (relative to the overall chlorinated ethene molar concentration) are listed in Table 32. As shown by the mole fractions in this table, chlorinated ethenes in monitoring well ND3MW29, located at the southern corner of the former surface impoundments and where NAPL was observed in the soil core, predominantly consist of TCE, which is believed to be present as a parent compound. In contrast, the TCE daughter product cis-1,2-DCE is the predominant chlorinated ethene in two of the three samples from ND2MW01 and in all three samples from NE1MW04. Both of these wells are further from the former surface impoundments boundary (and did not contain indications of NAPL in soil cores).

The ratios between PCE, TCE and cis-1,2-DCE are further illustrated on a tri-linear plot of these mole fractions (Figure 75). As shown on this figure, two samples from ND2MW01 and three samples from NE1MW04 plot in or near the lower left corner of the figure, corresponding to a predominantly (or entirely) cis-1,2-DCE mole fraction. The samples from ND3MW29 plot near the lower right corner of the figure, corresponding to a predominantly TCE mole fraction. Data for samples from well ND3MW02, located approximately 150 feet southeast of the former surface impoundments, plot as a mixture of parent TCE and daughter cis-1,2-DCE mole fractions. Thus, the evaluation of chlorinated ethene molar ratios provides a supporting line of evidence of contaminant degradation in Zone A groundwater, particularly in areas further from source materials and/or areas.

Geochemical Indicators

As noted above, geochemical conditions conducive to degradation processes can provide a secondary line of evidence for biodegradation of COIs in Site groundwater. Several key indicators of conditions favorable for anaerobic biodegradation were evaluated as part of groundwater sampling activities. Measurements/concentrations of these parameters in North Area Zone A monitoring wells during the November 2007 and June 2008 sampling events are summarized in Table 33. Discussions of each of the parameters and their significance as indicators of biodegradation are provided below:

Dissolved Oxygen – As noted above, CAH degradation through reductive dechlorination is an anaerobic process. Anaerobic bacteria generally cannot function at DO concentrations greater than 0.5 mg/L; DO concentrations below that threshold are considered tolerable for anaerobic degradation (EPA, 1998). As shown on Table 33, more than 75% of the DO measurements in North Area Zone A monitoring wells were below 0.5 mg/L, with the few exceedances only slightly above this threshold. Thus, the DO data suggest favorable conditions for anaerobic biodegradation.

Oxidation-Reduction Potential – ORP is an indicator of the relative tendency of a solution to accept or transfer electrons. ORP measurements (using a silver/silver chloride electrode) less than 50 millivolts (mV) indicate that reductive dechlorination is possible and ORP measurements less than -100 mV indicate such a degradation pathway is likely (EPA, 1998). ORP measurements listed in Table 33 for North Area Zone A monitoring wells were all less than 50 mV with approximately 25 % of those measurements less than -100 mV. Thus, the ORP data suggest favorable conditions for anaerobic biodegradation.

Temperature and pH – Temperature and pH conditions can affect the presence and activity of microbial populations. Temperatures greater than 20°C and pH values between 5 and 9 are considered optimal for anaerobic biodegradation (EPA, 1998). All measurements of these parameters in North Area Zone A monitoring wells (Table 33) fall within these ranges.

Fe (II) – During anaerobic biodegradation of organic carbon, ferric iron ((Fe(III)) can serve as an electron acceptor and be reduced to Fe(II). Thus the accumulation of Fe(II) can be an indicator of favorable anaerobic conditions. Ferrous iron concentrations greater than 1 mg/L are considered indicative that reductive dechlorination is possible (EPA, 1998). As shown on Table 33, all Fe(II) measurements in North Area Zone A monitoring wells were considerably higher than this 1 mg/L benchmark.

Nitrate – Nitrate can be used as an electron acceptor for anaerobic biodegradation of organic carbon via denitrification. Nitrate concentrations less than 1 mg/L are considered necessary for reductive dechlorination to occur (EPA, 1998), as otherwise denitrification will compete with reductive dechlorination for electrons. As shown on Table 33, nitrate concentrations in all but one North Area Zone A monitoring well sample were considerably lower than 1 mg/L, indicating acceptable conditions for reductive dechlorination.

Sulfide – Sulfate can serve as an electron acceptor for anaerobic biodegradation through sulfate reduction. This process produces sulfide, the accumulation of which can be used as an indicator of anaerobic conditions . Sulfide concentrations greater than 1 mg/L are considered indicative of favorable anaerobic conditions for reductive dechlorination (EPA, 1998). Only two of the North Area Zone A monitoring well samples exceeded this value.

Methane – Reductive dechlorination occurs in the ORP range corresponding to the production of methane from organic carbon degradation (methanogenesis). Methane concentrations in groundwater greater than 0.5 mg/L are considered indicative of anaerobic degradation (EPA, 1998). Methane concentrations greater than this level (approximately 8 mg/L) were observed at NE3MW05 (Table 33), where buried debris was observed in soil borings. At other monitoring wells, methane concentrations were less than 0.5 mg/L and anaerobic degradation by methanogenesis was generally not indicated.

TOC and BTEX – Biodegradable organic materials must be present as electron donors for reductive dechlorination of CAHs to occur. This organic carbon can be present as anthropogenic material such as benzene, toluene, ethylbenzene and xylene (BTEX) or landfill leachate, or as organic carbon naturally present in the groundwater-bearing unit. BTEX concentrations greater than 0.1 mg/L and TOC concentrations greater than 20 mg/L have been suggested as indicators of sufficient levels of organic carbon to support reductive dechlorination (EPA, 1998). BTEX or TOC concentrations were near or higher than these levels in approximately half of the North Area Zone A monitoring well samples (Table 33). Among the highest concentrations were observed in ND3MW29, at the southeast corner of the former surface impoundments, and in NE3MW05.

Ethene/Ethane – VC can degrade aerobically to carbon dioxide, or anaerobically as the final reductive dechlorination step to ethene and then ethane. Thus, the presence of ethane and/or ethene provides direct evidence for reductive dechlorination of VC. Ethene/ethane concentrations greater than 0.01 mg/L are considered indicative of VC degradation via this pathway; ethene/ethane concentrations greater than 0.1 mg/L are considered strongly indicative of that process (EPA, 1998). Nearly half of the North Area Zone A monitoring well samples had ethene/ethane concentrations above 0.01 mg/L and nearly a quarter of the ethene/ethane concentrations were also above 0.1 mg/L (Table 33).

Thus, as indicated by the above evaluation, most geochemical parameters were measured in Zone A groundwater at levels consistent with conditions conducive to reductive dechlorination. In particular, the key parameters of DO, ORP, Fe(II), and sulfide indicated favorable anaerobic conditions in nearly all samples evaluated. As further evidence, BTEX or TOC concentrations in nearly half of the samples suggested a sufficient level of organic carbon for reductive dechlorination within Zone A and nearly half of the samples contained ethene/ethane at levels demonstrating reductive dechlorination of VC, the final step in that degradation process.

Taken together, the evaluations of overall contaminant plume stability, presence of potential biodegradation daughter products, and favorable geochemical conditions described above provide multiple lines of evidence for biodegradation of groundwater COIs. As noted previously, biodegradation represents one of several processes affecting the extent and rate of contaminant migration in groundwater. The net overall effect of these various processes within the context of overall groundwater movement rates and directions can be assessed by considering the extent of observed contaminant migration relative to the timeframe over which that migration may have occurred. In the case of the Gulfco site, such an assessment is made through examination of the lateral extent of the primary groundwater COIs in Zone A relative to the operational period of the associated PSA, the former surface impoundments.

As described in Section 1.2.2, barge cleaning operations at the Site began in 1971. It is likely that use of the surface impoundments, which were constructed with a natural clay liner, began around that time as well. Discharges from the impoundments to surrounding areas were reported in 1974, and the impoundments are clearly visible in a 1974 aerial photograph (Appendix A). The impoundments were closed in 1982. Thus, chemicals introduced into the impoundments through barge wash waters and associated sludges have had the potential to migrate in groundwater for at least as long as 27 years (1982 to 2009) and potentially as long as 38 years (1971 to 2009).
As shown on Figures 65 through 74, the lateral extents of the primary groundwater COIs in Zone A are generally limited to an area of approximately 200 ft or less (and in many cases, much less) from the boundary of the former surface impoundments. Dividing this distance by the potential migration period estimates of 27 to 38 years would correspond to contaminant migration rates ranging from approximately 5 ft/year to 7 ft/year. These rates are at or slightly higher than the upper end of the Zone A average linear velocity estimate of 5 feet/year described in Section 3.4.5. However, when one considers that these rates correspond to the furthest extent of potentially observed migration and that NAPL was observed in the soil cores for monitoring wells ND3MW02 and NE3MW30B (located approximately 120 ft and 160 ft, respectively, south of the impoundments), the limited extent of COIs observed in Zone A is consistent with both the low estimated groundwater velocity and further reductions in contaminant migration due to biodegradation. The limited extent of contaminant migration, low groundwater velocity and demonstrated contaminant degradation also predict limited potential for future migration, as is further supported by the general stability of the dissolved COI plumes described above.

6.0 SUMMARY OF BASELINE HUMAN HEALTH RISK ASSESSMENT

A baseline human health risk assessment is the systematic, scientific characterization of potential adverse effects resulting from exposures to hazardous agents or situations, and was a requirement in the UAO. It is an essential element of the RI process under Superfund because it allows the environmental media to be evaluated in the context of potential human health exposure, toxicity and risk. The results of the BHHRA are used to support risk management decisions and determine if remediation or further action is warranted at a site.

The Final BHHRA was approved (with modifications that were submitted on March 31, 2010) by EPA on March 5, 2010. In order to evaluate potential risks from ingesting recreationally caught fish from the Intracoastal Waterway prior to collecting all of the RI data, a risk assessment of the fish ingestion pathway was conducted in 2007 using the fish tissue data collected as part of the RI. This evaluation, including modifications specified in EPA's approval letter dated June 29, 2007, was finalized in a July 18, 2007 letter report (PBW, 2007b). The discussion below briefly summarizes the evaluation and results of these risk assessments.

The risk assessment methodologies used to conduct these evaluations were based on the approached described by EPA in various risk assessment guidance documents and associated/supplemental guidance documents. All RI data were validated as described previously. Compounds were retained for further evaluation if they were detected in more than five percent of the samples for a given media. These data were then compared to appropriate human health screening levels (multiplied by a factor of 0.1 to ensure adequate protection) to identify the PCOCs that were quantitatively evaluated further in the BHHRA. This screening step was not conducted for the fish ingestion pathway. A comparison with background data was also conducted to ascertain which compounds detected in Site samples were present at statistically greater concentrations than background concentrations.

No COIs measured in surface water of the Intracoastal Waterway, North Area wetlands, and ponds exceeded $1/10^{th}$ of their respective screening value. Based on this comparison, the surface water pathway was eliminated from further evaluation in the BHHRA. Likewise, the pathway for off-site residential exposure to fugitive dust and VOC emissions from soils at the South Area and North Area was eliminated from further evaluation because no COIs were measured above $1/10^{th}$ of their screening criteria for this pathway. Several inorganic compounds in soil and sediment were eliminated from further evaluation in the BHHRA based on the comparison with background data.

6.1 EXPOSURE ASSESSMENT

The exposure assessment was developed using information about current land, surface water, and groundwater uses to identify reasonably anticipated current and future receptors. For each receptor, potential exposure pathways were identified based on the fate and transport of the chemicals in the environment, the point of contact with the exposure media, and possible routes of intake.

Based on the exposure assessment, it was assumed that potentially exposed populations for the South Area included: 1) future commercial/industrial workers; 2) future construction workers; and 3) a youth trespasser. Potentially exposed populations for the North Area were assumed to be the same. A contact recreation scenario was assessed for the sediment and surface water at both areas to represent the hypothetical person who occasionally contacts these media while swimming wading, or participating in other recreational activities. Potential impacts from fugitive dust generation and volatile compound emissions from South and North Area soils, and subsequent exposure to nearby residents was also evaluated, as was potential exposure to recreational anglers via the consumption of fish from the Intracoastal Waterway, as described previously.

Chemical exposure was quantified by estimating a daily dose or intake for each pathway given standard exposure assumptions using average and a reasonable maximum exposure concentration, which was generally represented by a 95th percent upper confidence limit on the mean.

6.2 TOXICITY ASSESSMENT

The toxicity assessment provides a description of the relationship between a dose of a chemical and the anticipated incidence of an adverse health effect. The purpose of the toxicity assessment is to provide a quantitative estimate of the inherent toxicity of PCOCs to be used in conjunction with the estimated dose calculated in the exposure assessment. Toxicity values for all PCOCs were obtained from EPA's on-line database -- Integrated Risk Information System (IRIS), as accessed during December 2008. IRIS is EPA's preferred source of toxicity information as described in their human health toxicity value hierarchy. Regional Screening Levels were not available when the project began and, as such, they were not used in the screening step or as a resource for toxicity information in the BHHRA.

6.3 RISK CHARACTERIZATION

Risk characterization is the integration of the exposure estimate (or dose) and the toxicity information to make quantitative estimates and/or qualitative statements regarding potential risk to human health. The risk assessment concluded that, for the numerous different exposure scenarios that were quantitatively evaluated, the cancer risk estimates and noncancer hazard indices for all of the current or future exposure scenarios were within EPA's acceptable risk range or below the target hazard index of 1 except for potential risks associated with future exposure to an indoor industrial worker if a building were constructed over the area of impacted groundwater in the North Area. It was recommended that the potential future exposure to workers in an enclosed space (if a building were constructed above the groundwater plume in the North Area) from vapors possibly emanating from groundwater and migrating to the indoor air be prevented. The BHHRA concluded that no further action or investigation is necessary for the other media at the Site since adverse risks are not expected to result from potential current or future exposure at the Site.

Because of the predicted unacceptable risk to future indoor industrial workers working in a building constructed over the affected Zone A groundwater plume in the North Area of the Site, a restrictive covenant that requires future building design to preclude indoor vapor intrusion was placed in the deed record for Lots 55, 56, and 57 (the lots on which the affected groundwater plume is located). This restriction would effectively make the vapor intrusion pathway incomplete and, as such, eliminate adverse risks. Estimated risks from Zone A groundwater at the South Area were below EPA's goals and, therefore, adverse risks associated with the vapor intrusion pathway are unlikely in this area. It is important to note that restrictive covenants are also in place for all parcels of land associated with the Site that restrict future land use to commercial/industrial purposes and preclude the use of underlying groundwater for drinking water or as a potable source, irrigation or agricultural purposes.

An uncertainty analysis was included in the BHHRA as well as the fish ingestion pathway evaluation to determine the significance of potential uncertainties and/or limitations associated with the data, assumptions used in the risk assessment, or other factors contributing to the conclusions. Efforts were made in the BHHRA and fish ingestion pathway evaluation to purposefully err on the side of conservatism in the absence of site-specific information. It is believed that the overall impact of the uncertainty and conservative nature of the evaluation results in an overly protective assessment. Therefore, for scenarios with risks and hazard indices within or below the Superfund risk range goal and target hazard index (or those that were screened out earlier in the process), it can be said with confidence that these environmental media and areas do not present an unacceptable risk.

6.4 BHHRA CONCLUSIONS

The BHHRA used data collected during the RI to evaluate the completeness and potential significance of potential human health exposure pathways indentified in CSMs for the South and North Areas of the Site. Potential cancer risks to future indoor industrial workers in the North Area were estimated using maximum Zone A groundwater concentrations and the Johnson & Ettinger Vapor Intrusion Model. If a building were constructed over the affected groundwater plume in the future and vapor intrusion to indoor air were to occur, the hypothetical risks for this pathway were predicted to be greater than 1×10^{-4} while the noncarcinogenic hazard indices (HIs) were estimated to be greater than 1. This scenario was evaluated despite current restrictive covenants on Lots 55, 56, and 57 that require future building design to preclude indoor vapor intrusion, which would effectively make this pathway incomplete and, as such, eliminate adverse risks. Estimated risks from Zone A groundwater at the South Area were below EPA's goals and, therefore, adverse risks associated with the vapor intrusion pathway are unlikely in this area. It is important to note that restrictive covenants are also in place for all parcels of land associated with the Site that restrict future land use to commercial/industrial purposes and preclude the use of underlying groundwater for drinking water or as a potable source, irrigation or agricultural purposes. Based on this information, the BHHRA concluded that there were not unacceptable cancer risks or non-cancer HIs for any of the identified current or future exposure scenarios except for future exposure to an indoor industrial worker if a building were constructed over impacted groundwater in the North Area.

7.0 SUMMARY OF ECOLOGICAL RISK ASSESSMENTS

The SOW for the RI/FS at the Site, provided as an Attachment to the UAO from the EPA, requires an Ecological Risk Assessment (ERA). The SOW specifies that the Respondents follow EPA's *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA, 1997). This guidance document proposes an eight-step approach for conducting a scientifically-defensible ERA:

1. Screening-Level Problem Formulation and Ecological Effects Evaluation;
2. Screening-Level Preliminary Exposure Estimate and Risk Calculation;
3. Baseline Risk Assessment Problem Formulation;
4. Study Design and Data Quality Objectives;
5. Field Verification of Sampling Design;
6. Site Investigation and Analysis of Exposure and Effects;
7. Risk Characterization; and
8. Risk Management.

After Steps 1 and 2 of the ERA, which constitutes the SLERA, it was concluded that it was necessary to proceed with the remaining ERA steps for a more thorough assessment (i.e., continue to Step 3 above) because potential adverse ecological effects for several receptors were predicted due to direct exposure to certain COPECs and receptors. This conclusion was based on exceedances of protective ecological benchmarks in soil, sediment, and surface water for direct contact toxicity as described in the SLERA. No literature-based food chain hazard quotients (HQs) exceeded unity and, as such, adverse risks to higher trophic level receptors are unlikely.

The Final BERA Work Plan & Sampling and Analysis Plan (SAP) and Final BERA Problem Formulation were submitted to the EPA on June 22, 2010 and approved (with modifications) by the EPA on August 4, 2010 (URS, 2010a; URS 2010b). The BERA Work Plan and SAP described a study to assess site-specific toxicity to invertebrates in the North Area soils, wetland sediments, Intracoastal Waterway sediments, and surface water from the wetland area. Toxicity testing of sediment was conducted with 28-day whole-sediment tests for wetland sediments and Intracoastal Waterway sediments using *Neanthes arenaceodentata* and *Leptocheirus plumulosus* as the test species. A 21-day whole sediment/soil toxicity test was performed for North Area soils using *Neanthes arenaceodentata* as the test species. Bioassays for the surface water were conducted on brine shrimp (*Artemia salina*) and assessed at a 48-hour duration. All of the BERA sediment and soil sample locations were chosen based on a concentration gradient of the COPECs identified in the SLERA.

Samples from Site and reference locations showed varying degrees of toxicity, but comparing toxicity results with analytical data did not indicate a consistent pattern or trend between samples or test species. A subsequent multivariate analysis that considered both chemical analytical data and physical parameters (e.g., grain size) concluded that there was not a single factor contributing to the observed toxicity in the sediment samples. A statistical evaluation of the toxicity data determined that there was no statistically significant difference in the toxicity observed in samples collected at the reference locations and the Site for sediment/soil exposure and that there was no toxicity associated with the surface water locations. Because of the lack of evidence of Site-related toxicity, development of ecologically-based remediation goals was not necessary. As such, no further ecological studies or ecologically-driven response actions are proposed.

As noted previously, the Final BERA Report is currently under EPA review. The approved BERA will determine the actual ecological risks for the site, and any BERA findings that are not consistent with statements in this RI Report will be addressed as appropriate in the Feasibility Study.

8.0 CONCLUSIONS

The nature and extent of COIs in Site environmental media was investigated in the RI through the installation and/or collection of 17 Site Intracoastal Waterway sediment samples, 9 background Intracoastal Waterway sediment samples, 4 Site Intracoastal Waterway surface water samples, 4 background Intracoastal Waterway surface water samples, 33 Site fish tissue samples, 36 background fish tissue samples, 190 South Area soil samples, 10 background soil samples, 41 off-site soil samples, 4 former surface impoundment cap soil borings, 29 North Area soil samples, 56 wetland sediment samples, 6 wetland surface water samples, 8 pond sediment samples, 6 pond surface water samples, 30 monitoring wells, 8 temporary piezometers, 5 permanent piezometers, and three soil borings. Most of these samples were analyzed for the list of COIs identified in the RI/FS Work Plan. The investigation conclusions are summarized by area/media below. The extent of COIs in these media were determined through comparisons to extent evaluation comparison values identified in the RI/FS Work Plan.

- Intracoastal Waterway Sediments – Certain PAHs (including some carcinogenic PAHs) and 4,4'-DDT were the only COIs detected in Site Intracoastal Waterway sediment samples at concentrations exceeding extent evaluation comparison values. These exceedances were limited to sample locations within or on the perimeter of the barge slip areas. Based on these data, the lateral extent of contamination in Intracoastal Waterway sediments, as defined by COI concentrations above extent evaluation comparison values, was identified as limited to small localized areas within the two Site barge slips. A vertical extent evaluation does not apply to this medium.

- Intracoastal Waterway Surface Water – No COIs were detected at concentrations above their respective extent evaluation comparison values in Intracoastal Waterway surface water samples collected adjacent to the Site.

- South Area Soils – COIs detected in South Area soils at concentrations exceeding extent evaluation comparison values included certain metals, PCBs and PAHs (including some carcinogenic PAHs). The lateral extent of contamination in South Area soils, as defined by COI concentrations above their respective extent evaluation comparison values, was identified as limited to the South Area of the Site and potentially a small localized area immediately west and adjacent to the Site on off-site Lot 20. The vertical extent of COIs at concentrations above comparison values in South Area soils was defined by samples from depths less than 4 feet, except for a sample collected from a depth of 4.5 feet during a removal action performed at a tank farm in the South Area.

- North Area Soils – The only COIs detected in at least one North Area soil sample at concentrations exceeding their respective extent evaluation comparison values were arsenic, iron, lead, 1,2,3-TCP, TCE, BaP, dibenz(a,h)anthracene, and PCBs. The lateral extent of contamination in North Area soils, as defined by COI concentrations above their respective extent evaluation comparison values, was identified as limited to small localized areas within this part of the Site where upland soils are present (i.e., within the area surrounded by wetlands). The vertical extent of COIs at concentrations above extent evaluation comparison values in North Area soils extends to the saturated zone at some locations. Within the extent of North Area soil contamination, a small localized area of buried debris (rope, wood fragments, plastic, packing material, etc.) was encountered at depths of three feet bgs or more south of the former surface impoundments.

- Wetland Sediments – COIs detected in at least one wetland sediment sample at concentrations exceeding their respective extent evaluation comparison values included certain metals, pesticides and PAHs (including carcinogenic PAHs). The lateral extent of contamination in wetland sediments, as defined by COIs concentrations above extent evaluation comparison values, was limited to specific areas within the Site boundaries and small localized areas immediately north and east of the Site. The vertical extent of COIs at concentrations above extent evaluation comparison values in wetland sediments was limited to the upper one foot of unsaturated sediment.

- Wetland Surface Water – Acrolein, copper, mercury, and manganese were the only COIs detected in at least one wetland surface water sample at concentrations exceeding their respective extent evaluation comparison values. The lateral extent of contamination in wetland surface water, as defined by COI concentrations above extent evaluation comparison values, was identified as limited to localized areas within and immediately north of the Site. A vertical extent evaluation does not apply to this medium.

- Ponds Sediment – Zinc and 4,4'-DDT were the only COIs detected in at least one pond sediment sample at concentrations exceeding their respective extent evaluation comparison values. These exceedances were all limited to the Small Pond at the Site, which effectively defined the extent of contamination in pond sediments. A vertical extent evaluation does not apply to this medium.

- Ponds Surface Water – Arsenic, manganese, silver and thallium were the only COIs detected in at least one pond surface water sample at concentrations exceeding their respective extent evaluation comparison values. The lateral extent of pond surface water contamination, as defined by these exceedances, is limited to the boundaries of the two ponds. A vertical extent evaluation does not apply to this medium.

- Groundwater – The uppermost water-bearing unit at the Site, Zone A, is generally encountered at an average depth of approximately 10 feet bgs and has an average thickness of approximately 8 feet. Saturated conditions were typically encountered at a depth of 5 to 15 feet bgs. Although some SVOCs and metals were detected in Zone A groundwater samples at concentrations exceeding extent evaluation comparison values, VOCs, particularly chlorinated solvents, their degradation products, and benzene, were the predominant COIs detected in Zone A groundwater samples. The highest COI concentrations in Zone A groundwater were generally observed in wells ND3MW02 and ND3MW29, where visible NAPL was observed in soil cores from the base of Zone A. Concentrations of several COIs, most notably 1,1,1-TCA, PCE, and TCE exceeded 1% of the compound solubility limit, which is often used as an indicator for the possible presence of NAPL. Thus the groundwater data from these wells are consistent with the observation of visible NAPL within the soil matrix. The extent of VOCs exceeding extent evaluation comparison values and DNAPL was generally limited to a localized area within the North Area, roughly over the southern half of the former surface impoundments area and a similarly-sized area immediately to the south of the former surface impoundments. The next underlying water-bearing unit, Zone B, is generally encountered at an average depth of approximately 19 feet bgs and has an average thickness of approximately 11 feet. The lateral extent of contamination in this zone was limited to VOCs detected in a single well (NE3MW30B) located south of the former surface impoundments. Concentrations of several COIs, most notably 1,1,1-TCA, PCE, and TCE, in NE3MW30B exceeded 1% of the compound solubility limit. These concentrations are consistent with the observation of visible NAPL within the soil matrix at the base of Zone B in the soil core from the boring at this location. The vertical extent of contamination in groundwater is limited to Zones A and B. Groundwater in these units is characterized by TDS concentrations of approximately 30,000 mg/L or more. These TDS concentrations are approximately triple the 10,000 mg/L level used by EPA to define water as non-potable and by TCEQ to identify Class 3 groundwater (groundwater not considered useable as drinking water). Due to naturally high salinity, Zones A and B, as well as underlying groundwater-bearing zones within the upper approximately 200 feet of the subsurface have not been used as a water supply source.

- Fish Tissue - In order to evaluate potential risks from ingesting recreationally caught fish from the Intracoastal Waterway, fish tissue samples were collected from four Site zones and one background area within the Intracoastal Waterway. Samples of red drum, spotted seatrout, southern flounder, and blue crab were analyzed for COIs selected based on Intracoastal Waterway sediment data. Hazard indices calculated based on the fish tissue data were several orders of magnitude below one, indicating that the fish ingestion pathway does not present an unacceptable noncarcinogenic health risk. Cancer risk estimates based on these data were 2 x 10^{-6} or less and thus within or below EPA's target risk range, indicating that adverse carcinogenic health effects are unlikely. Based on that evaluation, it was concluded that exposure to site-related COIs via the fish ingestion pathway does not pose a health threat to recreational anglers fishing at the Site, or their families.

The potential occurrence and significance of biodegradation processes affecting the fate and transport of primary COIs in Site groundwater was assessed through evaluations of: (1) whether the overall contaminant plume is stable or shrinking; (2) whether degradation of the primary contaminants, as evidenced by the presence of biodegradation daughter products, is occurring; and (3) whether the geochemical conditions that are favorable for such biodegradation processes are present. The stability of dissolved phase plumes for the primary groundwater COIs in Zone A was evaluated through examination of concentration data for those primary COIs for three groundwater sampling periods between July 2006 and June 2008. Time-series plots of these data showed that the primary groundwater COI plume areas exhibit generally stable or declining trends. Sections of the projected southern boundaries of the plume areas for 1,1,1-TCA, cis-1,2-DCE, PCE, and TCE show some limited expansion between the three sampling events. This indication is primarily due to concentration increases of those COIs in samples from well ND3MW02. Similar increasing concentrations of 1,1,1-TCA, cis-1,2-DCE, PCE, and TCE were also observed in groundwater samples from ND3MW29, located at the southwestern corner of the former surface impoundments. Visible indications of NAPL were observed in the soil cores from the borings for wells ND3MW02 and ND3MW29 at depths within the screened intervals of those two wells. The dissolution of residual NAPL containing 1,1,1-TCA, PCE and TCE within the local screened areas of ND3MW02 and ND3MW29 is a likely explanation for why concentrations of those COIs (and the degradation product cis-1,2-DCE) in samples collected from those wells were not observed to decrease over time as was observed in most of the other monitoring wells in the vicinity. Thus, despite a few exceptions for some COIs in the local areas around ND2MW29 and ND3MW02 in the plume interior where NAPL was observed in the soil core, the overall time-series plume area plots for the primary groundwater COIs clearly exhibit generally stable or declining trends.

Evidence of COI degradation is provided by the presence of likely biodegradation daughter products, most notably cis-1,2-DCE, and through consideration of molar ratios between chlorinated ethene parent and daughter products. Geochemical parameters were measured in Zone A groundwater samples at concentrations consistent with conditions conducive to reductive dechlorination, thereby providing supporting evidence for biodegradation. In particular, the key parameters of DO, ORP, Fe(II), and sulfide indicated favorable anaerobic conditions in nearly all samples evaluated. As further evidence, BTEX or TOC concentrations in nearly half of the samples suggested a sufficient level of organic carbon for reductive dechlorination within Zone A and nearly half of the samples contained ethene/ethane at levels demonstrating reductive dechlorination of VC, the final step in the chlorinated ethene degradation process.

Biodegradation represents one of several processes affecting the extent and rate of contaminant migration in groundwater. The net overall effect of these various processes within the context of overall groundwater movement rates and directions was assessed by considering the extent of observed contaminant migration relative to the timeframe over which that migration may have occurred. The former surface impoundments are the source of COIs in groundwater. Chemicals introduced into the former surface impoundments through barge wash waters and associated sludges have had the potential to migrate in groundwater for at least 27 years (1982 to 2009) and potentially for 38 years (1971 to 2009), based on the operational period and closure data of the impoundments.

The lateral extents of the primary COIs in Zone A groundwater are generally limited to an area of approximately 200 ft or less (and in many cases, much less) from the boundary of the former surface impoundments. Dividing this distance by the potential migration period estimates of 27 to 38 years would correspond to contaminant migration rates ranging from approximately 5 ft/year to 7 ft/year. These rates are consistent with estimated Zone A average linear groundwater velocities of up to 5 feet/year. However, considering that these migration rates correspond to furthest extent of potentially observed migration and that NAPL was observed in the soil cores for monitoring wells ND3MW02 and NE3MW30B (located approximately 120 ft and 160 ft, respectively, south of the impoundments), the limited extent of COIs observed in Zone A groundwater is consistent with both the low estimated groundwater velocity, and further reductions in contaminant migration due to biodegradation. The observed COI plume stability, low groundwater velocity, and demonstrated contaminant degradation also predict limited potential for future migration, as is further supported by the general stability of the dissolved COI plumes.

The BHHRA used data collected during the RI to evaluate the completeness and potential significance of potential human health exposure pathways indentified in CSMs for the South and North Areas of the Site. Potential cancer risks to future indoor industrial workers in the North Area were estimated using maximum Zone A groundwater concentrations and the Johnson & Ettinger Vapor Intrusion Model. If a building were constructed over the affected groundwater plume in the future and vapor intrusion to indoor air were to occur, the hypothetical risks for this pathway were predicted to be greater than 1 x 10^{-4} while the noncarcinogenic hazard indices (HIs) were estimated to be greater than 1. This scenario was evaluated despite current restrictive covenants on Lots 55, 56, and 57 that require future building design to preclude indoor vapor intrusion, which would effectively make this pathway incomplete and, as such, eliminate adverse risks. Estimated risks from Zone A groundwater at the South Area were below EPA's goals and, therefore, adverse risks associated with the vapor intrusion pathway are unlikely in this area. It is important to note that restrictive covenants are also in place for all parcels of land associated with the Site that restrict future land use to commercial/industrial purposes and preclude the use of underlying groundwater for drinking water or as a potable source, irrigation or agricultural purposes. Based on this information, the BHHRA concluded that there were not unacceptable cancer risks or non-cancer HIs for any of the identified current or future exposure scenarios except for future exposure to an indoor industrial worker if a building were constructed over impacted groundwater in the North Area.

The Final SLERA used data collected during the RI to evaluate the completeness and potential significance of potential ecological exposure pathways indentified in CSMs for terrestrial and aquatic ecosystems at the Site. The SLERA concluded that it was necessary to proceed to a site-specific BERA because of exceedances of protective ecological benchmarks for direct contact toxicity to invertebrates in the sediment in the wetlands and Intracoastal Waterway, soil in the North Area, and surface water in the wetlands at the Site. No literature-based food chain hazard quotients (HQs) exceeded unity (1) in the SLERA and, as such, adverse risks to higher trophic level receptors were considered unlikely and were not evaluated further in the BERA.

In accordance with the SLERA conclusions, and per the study outlined in the BERA WP-SAP, data collected for the BERA included analytical chemistry analysis and toxicity testing of soil, sediment, and surface water samples corresponding to a gradient of COPEC concentrations. Based on these data, the BERA concluded that there was no statistically significant difference in the toxicity observed in samples collected at reference locations and the Site for sediment/soil exposure and that there was no toxicity associated with the surface water locations. Because of the lack of evidence of Site-related toxicity, development of ecologically-based remediation goals was not necessary. As such, no further ecological studies or ecologically-driven response actions are proposed. The Final BERA Report is currently under EPA review. The approved BERA will determine the actual ecological risks for the site, and any BERA findings that are not consistent with statements in this RI Report will be addressed as appropriate in the Feasibility Study.

9.0 REFERENCES

Ashworth, J. B. and J. Hopkins, 1995. Aquifers of Texas: Texas Water Development Board Report 345, 69 p.

Baker, E. T., Jr., 1979. Stratigraphic and hydrogeologic framework of part of the coastal plain of Texas: Texas Department of Water Resources Report 236, 43 p.

Barnes, V. E., 1987. Geologic Atlas of Texas – Beeville-Bay City Sheet. The University of Texas at Austin – Bureau of Economic Geology.

Brazoria County, Texas (Brazoria County), 1937. Real Property Records. Page D-112.

Brazoria County, Texas (Brazoria County), 1939. Real Property Records. Pages D-10, D-11, D-12, D-13, and D-86.

Brazoria County, Texas (Brazoria County), 1945. Real Property Records. Page D-88.

Brazoria County Facts (Facts), 2006. "Pilots Take to Skies to Eradicate Mosquitoes." June 16.

Brazoria County Facts (Facts), 2008a. "County District Responds to Mosquito Outbreak." September 8.

Brazoria County Facts (Facts), 2008b. "State Adds to Mosquito-Spraying Efforts." September 26.

Brown, David S., Grant L. Snyder, and R. Lynn Taylor. 1998. Mercury Concentrations in Estuarine Sediments, Lavaca and Matagorda Bays, Texas, 1992. U.S. Geological Survey Water Resources Investigations Report 98-4038.

Carden, Clair A., 1982. Fish Marine Services, Freeport, Texas, Pond Closure Certification. August 18.

Chowdhury, A. H. , R. Bodhici, and J. Hopkins, 2006. Hydrochemistry, Salinity Distribution, and Trace Constituents: Implications for Salinity Sources, Geochemical Evolution, and Flow Systems Characterization, Gulf Coast Aquifer, Texas., in Mace, R. E., S. C. Davidson, E. S. Angle, and W. F. Mullican III, eds., Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365, pp. 81 – 128.

Chowdhury, A. H. and M. J. Turco, 2006. Geology of the Gulf Coast Aquifer, Texas, in Mace, R. E., S. C. Davidson, E. S. Angle, and W. F. Mullican III, eds., Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365, pp. 23 – 50.

City of Freeport (Freeport), 2009. Code of Ordinances Title XV Sections 155.039 and 155.042. Accessed through http://www.amlegal.com/nxt/gateway.dll/Texas/freeport_tx/cityoffreeporttexascodeofordinances?f=templates$fn=default.htm$3.0$vid=amlegal:freeport_tx, accessed October 2.

Davidson, S. C. and R. E. Mace, 2006. Aquifer of the Gulf Coast of Texas: an overview, in Mace, R. E., S. C. Davidson, E. S. Angle, and W. F. Mullican III, eds., Aquifers of the Gulf Coast of Texas: Texas Department of Water Resources Report 365, pp. 1 – 21.

The Dow Chemical Company (Dow), 2009. Dow Texas Operations - Freeport, Texas - Meteorological Station Data. Provided July 6.

Ecology and Environment, Inc. (EEI), 1989. Memorandum from Jairo Guevera to Ed Sierra of EPA Regarding Environmental Priority Initiative Preliminary Assessment of Fish Engineering Construction, Inc. August 2.

Ecology and Environment, Inc. (EEI), undated a. Screening Site Inspection of Hercules Offshore Corporation.

Ecology and Environment, Inc. (EEI), undated b. Screening Site Inspection of Fish Engineering and Construction, Inc.

Federal Emergency Management Agency (FEMA), 2009, Flood Insurance Rate Map Number 48039CO785I, Brazoria County, Texas and Incorporated Area Panel 785 of 580, revised May 4, 1992. Accessed at http://map1.msc.fema.gov/idms/IntraView.cgi?KEY=71856875&IFIT=1 on June 24.

Fish Engineering & Construction, Inc. (Fish), 1982. Application for Exemption for Construction Permit and Operating Permit. Letter from G.J. Gill to Bill Stewart of Texas Air Control Board. April 14.

Freeze, R. Allan, and John A. Cherry, 1979. Groundwater. Prentice-Hall, Inc.

Gibbons, Robert D., 1994. Statistical Methods for Groundwater Monitoring. John Wiley & Sons, Inc.

Guevara, Jairo, 1989. Record of Communication for Reconnaissance Inspection of Former Surface Impoundments of Fish Engineering & Construction, Inc. November 28.

Henry, Walter K. and J. Patrick McCormack, 1975. Hurricanes on the Texas Coast. Center for Applied Geosciences, College of Geosciences, Texas A&M University.

Hercules Offshore Corporation (Hercules), 1989a. Correspondence from Raymond H. Ellison, Jr. to Jairo A. Guevara of Ecology and Environment, Inc. December 8.

Hercules Offshore Corporation (Hercules), 1989b. Correspondence from Raymond H. Ellison, Jr. to Jairo A. Guevara of Ecology and Environment, Inc. December 18.

Kwader, Thomas, 1986. The use of geophysical logs for determining formation water quality: Ground Water, v. 24, p. 11- 15.

Lake Jackson News, 1957. "Spray Plane Swats Mosquito via Two Day Oil Spray Job." August 8.

Losack, Billy, 2005. Personal communication with Pastor, Behling & Wheeler, LLC. July.

LT Environmental, Inc. (LTE), 1999. Site Characterization Report. Hercules Marine Service Site Freeport, Brazoria County Texas. June.

McCarty, P.L., and J.T. Wilson, 1992. "Natural anaerobic treatment of a TCE Plume, St. Joseph, Michigan NPL Site," in US EPA Bioremediation of Hazardous Wastes. EPA/600/R-92/126. pp. 47-50.

McGowen, J. H., L. F. Brown, T. J. Evans, W. L. Fisher, and C. G. Groat, 1976. Environmental geologic atlas of Texas coastal zone – Bay City – Freeport Area: The University of Texas at Austin – Bureau of Economic Geology, Austin, Texas, 97p.

Miller, Gary G., 2010. Personal communication with Fran Henderson of BCMCD. October 27.

National Oceanic and Atmospheric Administration (NOAA), 2009a. National Weather Service Forecast Office, Houston/Galveston Texas. http://www.srh.noaa.gov/hgx/climate/gls/normals/gls_summary.htm. Accessed April 16.

National Oceanic and Atmospheric Administration (NOAA), 2009b. NOAA Water Level and Meteorological Data Report – Hurricane Ike. July 2.

National Oceanic and Atmospheric Administration (NOAA), 2009c. http://www.tidesandcurrents.noaa.gov/station_info.shtml?stn=8772447%20Uscg%20Freeport,%20TX. Accessed September 15.

National Research Council (NRC), 2000. Natural Attenuation for Groundwater Remediation. National Academy Press.

Nyer, Evan, Polly Mayfield and Joseph Hughes, 1998. "Beyond the AFCEE Protocol for Natural Attenuation." Groundwater Monitoring and Remediation. Volume 18, No. 3. pp. 70-77.

Pastor, Behling & Wheeler, LLC (PBW), 2005. Health and Safety Plan, Gulfco Marine Maintenance Site, Freeport, Texas. August 17.

Pastor, Behling & Wheeler, LLC (PBW), 2006a. Final RI/FS Work Plan, Gulfco Marine Maintenance Site, Freeport, Texas. May 16.

Pastor, Behling & Wheeler, LLC (PBW), 2006b. Sampling and Analysis Plan – Volume I, Field Sampling Plan, Gulfco Marine Maintenance Site, Freeport, Texas. March 14.

Pastor, Behling & Wheeler, LLC (PBW), 2006c. Sampling and Analysis Plan – Volume II, Quality Assurance Project Plan, Gulfco Marine Maintenance Site, Freeport, Texas. March 14.

Pastor, Behling & Wheeler, LLC (PBW), 2007a. Letter to Mr. Gary Miller and Ms. Barbara Nann Re: Documentation of Aboveground Storage Tank Sampling Activities. April 4.

Pastor, Behling & Wheeler, LLC (PBW), 2007b. Letter to Mr. Gary Miller and Ms. Barbara Nann Re: Intracoastal Waterway Fish Ingestion Pathway Human Health Risk Assessment. July 18.

Pastor, Behling & Wheeler, LLC (PBW), 2009. Final Nature and Extent Data Report, Gulfco Marine Maintenance Site, Freeport, Texas. May 29.

Pastor, Behling & Wheeler, LLC (PBW), 2010a. Final Baseline Human Health Risk Assessment, Gulfco Marine Maintenance Site, Freeport, Texas. March 31.

Pastor, Behling & Wheeler, LLC (PBW), 2010b. Final Screening-Level Ecological Risk Assessment Report, Gulfco Marine Maintenance Site, Freeport, Texas. May 3.

Pastor, Behling & Wheeler, LLC (PBW), 2011. Final Removal Action Report, Gulfco Marine Maintenance Site, Freeport, Texas. March 23.

Price, W. A., 1934. Lissie Formation and Beaumont Clay in South Texas: Bulletin of the American Association of Petroleum Geologists, v. 18, no. 7, p. 948-959.

Roop, Stephen S., Wang, Daryl U., Dickinson, Richard W., and Clarke, Gordon M., 1993. Closure of the GIWW and its Impact on the Texas Highway Transportation System: Final Report. Texas Transportation Institute, Research Report 1283-2F, September 1993.

Sandeen, W. M. and J. B. Wesselman, 1973. Groundwater resources of Brazoria County, Texas: Texas Department of Water Resources, 199 p.

Siefert, W. John Jr. and Christopher Drabek, 2006. History of Production and Potential Future Production of the Gulf Coast Aquifer, in Mace, R. E., S. C. Davidson, E. S. Angle, and W. F. Mullican III, eds., Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365, pp. 261-271.

Sellards, E. H. W. S. Adkins, and F. B. Plummer, 1932. The Geology of Texas, Volume 1, Stratigraphy: The University of Texas at Austin, Bureau of Economic Geology, 1007 p.

Solis, R.F. 1981. Upper Tertiary and Quaternary depositional systems, Central Coastal Plain, Texas – regional geology of the coastal aquifer and potential liquid – waste repositories: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations 108, 89p.

Teeter, A.M., Brown, G.L., Alexander, M.P., Callegan, C.J., Sarruff, M.S., and McVan, D.C., 2002. Wind-wave resuspension and circulation of sediment and dredged material in Laguna Madre, Texas, ERDC/CHL TR-02-XX, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Texas Commission on Environmental Quality (TCEQ), 2006. *Update to Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas.* RG-263 (Revised). Remediation Division. January.

Texas Commission on Environmental Quality (TCEQ), 2009a. Technical Guideline No. 3 – Landfills. Revised June 12.

Texas Commission on Environmental Quality (TCEQ), 2009b. Houston Intercontinental Airport Wind Rose. http://www.tceq.state.tx.us/assets/public/compliance/monops/air/windroses/iahall.gif. Accessed July 3, 2009.

Texas Commission on Environmental Quality (TCEQ), 2010. RG-366/TRRP-8 – Groundwater Classification. March.

Texas Department of Health (TDH), 2004. Public Health Assessment, Gulfco Marine Maintenance, Freeport, Brazoria County, Texas. Report Prepared for Agency for Toxic Substances and Disease Registry. April 19.

Texas Department of State Health Services (TDSHS), 2005. Services Seafood and Aquatic Life Group. On-line database and maps showing shellfish harvesting bans and fish consumption advisories and bans. www.tdh.state.tx.us/bfds/ssd/.

Texas Department of Transportation (TxDOT), 2001. Transportation Multimodal Systems Manual. September.

Texas Natural Resource Conservation Commission (TNRCC), 1997a. Notice of Violation, TNRCC Air Account No. BL-0118-V, Correspondence to Larry Ballinger of Hercules Marine Services Corp. March 13.

Texas Natural Resource Conservation Commission (TNRCC), 1997b. Interview of Mickey Wayne Tiner by Brian Lynch. August 6.

Texas Natural Resource Conservation Commission (TNRCC), 2000a. Screening Site Inspection Report, Gulfco Marine Maintenance, Inc. Freeport, Brazoria County, Texas TXD 055 144 539. Prepared in cooperation with the U.S. Environmental Protection Agency. July.

Texas Natural Resource Conservation Commission (TNRCC), 2000b. Screening Site Inspection Photographs. January 24-27.

Texas Natural Resource Conservation Commission (TNRCC), 2002. HRS Documentation Record, Gulfco Marine Maintenance, Inc. Freeport, Brazoria County, Texas TXD 055 144 539. Prepared in cooperation with the U.S. Environmental Protection Agency. February.

Texas Parks and Wildlife Department (TPWD), 2009. Online fishing reports by region. http://www.tpwd.state.tx.us/fishboat/fish/action/reptmap.php?EcoRegion=GC. Accessed October 5.

Texas Water Commission (TWC), 1986a. Solid Waste Compliance Monitoring Inspection Report, Fish Engineering & Construction, Inc. February 27.

Texas Water Commission (TWC), 1986b. Interoffice Memorandum from Randall Denover Regarding July 31, 1986 Telephone Conversation with Tom Randolph of Fish Engineering Marine Operations. July 31.

United States Army Corps of Engineers (USACE), 2006. Waterborne Commerce of the United States, Calendar Year 2006. IWR-WCUS-06-2.

United States Army Corps of Engineers (USACE), 2008. October 2008 Hydrograph Bulletin, Channels With Project Depths Under 25 Feet, Galveston District. October, 2008.

United States Army Corps of Engineers (USACE), 2009. Personal communication with Ms. Alicia Rea. July.

United States Census Bureau (USCB), 2009. Population Finder: Freeport, Texas 2000 U.S. Census Data. http://factfinder.census.gov/servlet/SAFFFacts?_event=&geo_id=16000US4827420&_geoContext=01000US%7C04000US48%7C16000US4827420&_street=&_county=Freeport&_cityTown=Freeport&_state=04000US48&_zip=&_lang=en&_sse=on&ActiveGeoDiv=&_useEV=&pctxt=fph&pgsl=160&_submenuId=factsheet_1&ds_name=null&_ci_nbr=null&qr_name=null&reg=null%3Anull&_keyword=&_industry=&show_2003_tab=&redirect=Y. Accessed October 5, 2009.

United States Environment Protection Agency (EPA), 1980. Potential Hazardous Waste Site Inspection Report. July 15.

United States Environmental Protection Agency (EPA), 1988a. Guideline for Ground-Water Classification Under EPA Ground Water Protection Strategy. EPA/440/6-86/007. June.

United States Environment Protection Agency (EPA), 1988b. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (Interim Final). OSWER Directive 9355.3-01. EPA/540/G-89/004. October.

United States Environment Protection Agency (EPA), 1992. Handbook of RCRA Ground-Water Constituents: Chemical & Physical Properties. EPA/530/R-92/022. June.

United States Environmental Protection Agency (EPA), 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Office of Solid Waste and Emergency Response. OSWER 9285.7-25. EPA 540-R-97-006. June.

United States Environmental Protection Agency (EPA), 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. USEPA Office of Research and Development. EPA/600//R-98/128. September.

United States Environmental Protection Agency (EPA), 2002. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. Office of Emergency and Remedial Response. EPA 540-R-01-003. OSWER 9285.7-41. September.

United States Environmental Protection Agency (EPA), 2005. Community Involvement Plan, Gulfco Marine Maintenance Superfund Site, Freeport, Brazoria County Texas. Region 6. August.

United States Environmental Protection Agency (EPA), 2007. PRO UCL Version 4.0 Statistical software available at http://www.epa.gov/nerlesd1/ and PRO UCL Version 4.0 User's Guide. EPA 600/R-07/038. EPA Technology Support Center. Characterization and Monitoring Branch. February.

United States Fish and Wildlife Service (USFWS), 2005. Memorandum to Gary Miller from Barry Forsythe Re: Site visit trip report, Gulfco Marine Maintenance Superfund Site. June 13, 2005.

United States Fish and Wildlife Service (USFWS), 2008. National Wetlands Inventory, Online Wetlands Mapper. http://wetlandsfws.er.usgs.gov/wtlnds/launch.html. Accessed July 9, 2008.

United States Geological Survey (USGS), 2006. National Field Manual for the Collection of Water-Quality Data. Chapter A6 – Field Measurements, Dissolved Oxygen, Version 2.1. June.

URS Corporation (URS), 2010a. Final Baseline Ecological Risk Assessment Work Plan & Sampling and Analysis Plan, Gulfco Marine Maintenance Site, Freeport, Texas. September 2.

URS Corporation (URS), 2010b. Final Baseline Ecological Risk Assessment Problem Formulation Report, Gulfco Marine Maintenance Site, Freeport, Texas. September 2.

URS Corporation (URS), 2010c. Final Preliminary Site Characterization Report, Gulfco Marine Maintenance Site, Freeport, Texas. November 30.

URS Corporation (URS), 2011. Final Baseline Ecological Risk Assessment Report, Gulfco Marine Maintenance Site, Freeport, Texas. March 31.

Vogel, Tim M., Craig S. Criddle, and Perry L. McCarty, 1987. "Transformations of Halogenated Aliphatic Compounds," Environmental Science and Technology, Vol. 21. pp. 722-736.

Vogel, Tim M. and Perry L. McCarty, 1987. "Abiotic and Biotic Transformations of 1,1,1-Trichloroethane under Methanogenic Conditions," Environmental Science and Technology, Vol. 21. pp. 1208-1213.

Walker, H.M., 1994. Application for a TNRCC Construction Permit for Hercules Marine Services Corporation of Freeport, Texas. May 3.

Wiedemeier, T.H., J.T. Wilson, D.H. Kampbell, R.N. Miller, and J.E. Hansen, 1999. Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination in Groundwater. Air Force Center for Environmental Excellence. March 9.

Wilson, John T., 2002. "Current State of Practice for Evaluation of Oxidative Reduction Processes Important to the Biological and Chemical Destruction of Chlorinated Organic Compounds in Ground Water" in Workshop on Monitoring Oxidation-Reduction Processes for Groundwater Restoration, Dallas, Texas. EPA/600/R-02/0002. pp. 29-34. January.

Wittenbrink, Chris. 2009. CR Consulting, Inc. Personal communication. October 19.

Yan, J., B.A. Rash, F.A. Rainey, and W.M. Moe, 2008. "Isolation of novel bacteria within the Chloroflexi capable of reductive dechlorination of 1,2,3-trichloropropane." Environmental Microbiology. Vol. 11. No. 4: pp.833-843. November.

Zimmerman, Andrew R. and Ronald Brenner, 1994. "Denitrification, nutrient regeneration and carbon mineralization in sediments of Galveston Bay, Texas, USA." Marine Ecology Progress Series. Vol. 114: pp. 275-288. November 17.

TABLES

TABLE 1 – SITE HISTORY SUMMARY

Date	Activity	Key References[1]
Undetermined	Easement on parts of Site conveyed to US for the work of "constructing, improving, and maintaining an Intracoastal Waterway", and for "the deposit of dredged material."	Brazoria County, 1937, 1939, and 1945.
1944	Dredge spoil placement at Site appears to be indicated on aerial photograph.	Aerial photograph in Appendix A.
1960s	Temporary welding activities occasionally performed on part of Site south of Marlin Avenue.	Losack, 2005.
May 1970	At least part of Site sold by Mr. and Mrs. B. L. Tanner to Gulfco Marine Maintenance, Inc. (Gulfco).	TNRCC, 2000a.
1971-1979	Site[2] operated by Gulfco as barge cleaning facility.	TNRCC, 2000a.
1971-1981	Three on-site surface impoundments used for barge cleaning wash waters. Impoundments were described as earthen lagoons with a natural clay liner. Impoundments were reportedly 3 feet deep.	TNRCC, 2000a. Impoundment depths from Guevara, 1989.
July 1974	Discharge from impoundments "contaminated surface water outside of ponds" and "damaged some flora north of the ponds."	EPA, 1980.
February 1976	Company fined $3,500 for unauthorized discharges from impoundments.	EPA, 1980.
August 1979	Discharge from impoundments "contaminated surface water outside of ponds."	EPA, 1980.
November 12, 1979	Fish Engineering and Construction, Inc. (Fish) purchased Site from Gulfco.	EPA, 1980.
1979-1989	Site operated by Fish for barge servicing and cleaning. Primary operations consisted of draining chemical barges and removing product heels. Barges were washed with hot water and/or detergent solution and air dried prior to any repair work (welding and sandblasting). Barge heels were stored in small tanks to be sold for reuse and recovery. Wash waters were stored in impoundments until approximately 1981, stored in tanks on floating barges, and eventually sent off-site for deep well injection at Empak in Deer Park, Texas.	TNRCC, 2000a. Fish, 1982 includes process flow diagram and associated site maps and detailed descriptions of chemical and wash water handling and storage procedures and locations. Disposal information provided in TWC, 1986a.
July 1980	Some erosion on impoundment levees noted by Texas Department of Water Resources personnel during site inspection.	EPA, 1980.
1981-1999(?)	Wash waters stored in tanks or floating barges.	TNRCC, 2000a.

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TABLE 1 – SITE HISTORY SUMMARY

Date	Activity	Key References[1]
1982	Surface impoundments closed under Texas Water Commission (TWC) direction (Impoundments were taken out of service on October 16, 1981). Closure activities involved removal of liquids and most of the impoundment sludges prior to closure. The sludge that was hard to excavate (approximately 100 cubic yards of material) was solidified with soil and left mainly in Impoundment 2. The impoundments were capped with three-feet of clay and a hard wearing surface.	TNRCC, 2000a including Fish/TWC closure correspondence dated: May 14, 1981. June 29, 1981. November 17, 1981. December 21, 1981. January 26, 1982. February 26, 1982. March 17, 1982. March 31, 1982 (phone memo). April 7, 1982. April 29, 1982. May 21, 1982. May 26, 1982. June 21, 1982. August 24, 1982 (closure certification letter). Guevara, 1989 includes closure details provided by Fish personnel.
1982	Four monitoring wells (Fish wells) installed on impoundment area perimeter.	TNRCC, 2000a.
April 1982	Fish application for exemption from Texas Air Control Board (TACB) construction permit and operating permit procedures. Letter includes detailed operation descriptions; including tank inventories, process diagrams, and site maps.	Fish, 1982.
December 1983	Fish monitoring wells plugged.	TNRCC, 2000a.
1986	July 31 TWC telephone conversation with Tom Randolph of Fish detailing facility operations.	TWC Memorandum (TWC, 1986b) summarizing conversation.
January 20, 1989	Hercules Offshore Corporation purchased Site (except Lot 56) from Fish	TNRCC, 2000a.
1989-1999	Hercules (later Hercules Marine Services) operations included barge cleaning and repair. Product heels were removed from barges into aboveground storage tanks and subsequently sold as product. Barges were washed with water and detergent. Wash waters were stored in storage tanks and then either disposed to an off-site injection well or transported to Empak in Deer Park, Texas.	TNRCC, 2000a.
January 1989	Three monitoring wells installed around former impoundments by Pilko & Associates for Hercules.	Hercules, 1989a and 1989b - correspondence to Ecology and Environment, Inc. dated December 8, 1989 (boring logs) and December 18, 1989 (analytical reports).

TABLE 1 – SITE HISTORY SUMMARY

Date	Activity	Key References[1]
August 1989	Environmental Priority Initiative Preliminary Assessment of Fish Operations prepared. Included description of site history, identification of Solid Waste Management Units (SWMUs), and potential pathways.	EEI, 1989.
November 1989	Reconnaissance Inspection of Former Impoundments prepared based on November 28, 1989 site visit. Described impoundment closure procedures. Described site conditions observed.	Guevara, 1989.
November 1989	Screening Site Inspection by Ecology and Environment performed on November 28-29, 1989. Reports describe site conditions, source waste characteristics, and potential pathways. Includes aerial photograph and site map showing tank and SWMU locations.	EEI, undated a and b.
February 1990 – September 1991	Mickey Tiner, Project Manager for Hercules, indicated that Hercules discharged wastewater from barge cleaning operations directly into the Intracoastal Waterway at night.	TNRCC, 1997b.
May 1994	Hercules Marine Service Application for Texas Natural Resource Conservation Commission (TNRCC) Construction Permit prepared. Included schematic diagrams of barge unloading process, map of tank locations, discussion of sand blasting process, and emissions evaluation.	Walker, 1994.
March 1997	TNRCC Notice of Violation from December 5, 1996 inspection. Notes "in compliance with barge cleaning regulations, not in compliance with surface coating regulations." Report includes Hercules descriptions of barge cleaning and stripping procedures, and tank inventories from SPCC plan.	TNRCC, 1997a.
May 4, 1998	Hercules filed for Chapter 7 bankruptcy.	TNRCC, 2000a.
1999	LT Environmental, Inc. performed site investigation for LDL Coastal Limited LP (LDL). Records reviewed for Site investigation included EPA and TNRCC documents and correspondence, previous sampling reports, and historical aerial photographs.	LTE, 1999.
August 2, 1999	Site (except Lot 56) acquired by LDL from bankruptcy court.	TNRCC, 2000a.

Notes:

[1]See Section 9.0 for reference information.
[2]Unless indicated otherwise, the term "Site" is intended as a generic reference to the Gulfco Marine Maintenance Superfund Site and is not intended to differentiate between specific lots on the Site.

TABLE 2 – REMEDIAL INVESTIGATION COMMUNICATION SUMMARY

Investigation	Communication Method	Date	Description
Intracoastal Waterway - Sediment	Letter	09-18-06	Gulfco Restoration Group (GRG)[1] provided Phase 1 Site and background data and proposed collection of three additional samples.
	Letter	11-14-06	EPA approved (with modifications) GRG's 9-18-06 letter.
	Letter	01-12-07	GRG provided unvalidated laboratory report for one sample and explained that other two samples were not collected due to insufficient sediment thicknesses per 11-14-06 EPA letter.
	Letter	03-13-07	GRG provided validated data for final Intracoastal Waterway sample.
Intracoastal Waterway - Surface Water	Letter	09-18-06	GRG provided Site and background data. No additional sampling proposed.
Intracoastal Waterway - Fish Tissue	Letter	09-18-06	GRG provided Phase 1 Site and background sediment data and proposed that no fish tissue collection be performed based on those data.
	Letter	11-14-06	EPA responded to 9-18-06 letter – required collection of fish tissue samples and specified sample analyte list.
	Letter	11-20-06	GRG provided replacement pages to RI/FS Field Sampling Plan and Quality Assurance Project Plan to describe details of fish tissue sampling program in accordance with 11-14-06 EPA letter.
	Letter	01-12-07	GRG documented EPA approval (on 12-14-06) for collection of a reduced number (six) of red drum samples.
	Letter	03-20-07	GRG provided fish tissue analytical data and fish ingestion pathway human health risk assessment.
	Letter	06-29-07	EPA approved (with modifications) fish ingestion pathway human health risk assessment provided in GRG's 3-20-07 letter and requested resubmittal of revised letter.
	Letter	07-18-07	GRG provided revised version of fish ingestion pathway human health baseline risk assessment incorporating modifications from EPA 6-29-07 letter.

TABLE 2 – REMEDIAL INVESTIGATION COMMUNICATION SUMMARY

Investigation	Communication Method	Date	Description
South Area Soils	Letter	09-11-07	GRG provided Phase 1 data and proposed Phase 2 investigation. Letter concluded that eastern extent of contamination had been identified.
	Letter	10-30-07	EPA approved (with modifications) Phase 2 investigation proposed in GRG's 9-11-07 letter and requested resubmittal of revised letter.
	Letter	11-28-07	GRG resubmitted revised version of Phase 1 data and proposed Phase 2 investigation letter incorporating modifications from EPA 10-30-07 letter.
	e-mail	12-13-07	GRG provided Phase 2 data and concluded that western extent of contamination had been identified.
Residential Surface Soil Investigation	Letter	08-20-07	GRG proposed analyte (lead) for off-site (Lot 19/20) samples based on data for Lots 21, 22, and 23 surface soil samples.
	Letter	09-06-07	EPA approved (with modification) Lot 19/20 analyte (lead) proposed in GRG's 8-20-07 letter and requested resubmittal of revised letter.
	Letter	09-21-07	GRG resubmitted revised version of proposed Lot 19/20 sample analyte letter incorporating modification from EPA 9-6-07 letter.
	e-mail	10-10-07	GRG provided unvalidated data for Lot 19/20 samples with preliminary conclusion (subject to validation) that no additional residential soil sampling was needed.
	e-mail	10-15-07	GRG provided validated data for Lot 19/20 samples with note that no data were qualified during validation process.
North Area Soils	Letter	09-11-07	GRG provided Phase 1 data and proposed Phase 2 investigation. Letter concluded that lateral extent of contamination had been determined, but proposed one additional sample to assess vertical extent of contamination and six additional borings to evaluate potential source areas.
	Letter	10-30-07	EPA approved (with modifications) Phase 2 investigation proposed in GRG's 9-11-07 letter and requested resubmittal of revised letter.
	Letter	11-28-07	GRG resubmitted Phase 1 data and proposed Phase 2 investigation letter incorporating modifications from EPA 10-30-07 letter.
	Letter	04-08-08	GRG provided validated Phase 2 data.

TABLE 2 – REMEDIAL INVESTIGATION COMMUNICATION SUMMARY

Investigation	Communication Method	Date	Description
Wetlands – Sediment	Letter	11-28-06	GRG provided figure with proposed Phase 2 wetland sediment/surface water sample locations.
	e-mail	12-01-06	GRG provided revised figure with proposed Phase 2 wetland sediment/surface water locations (included one additional sediment sample location requested by EPA).
	e-mail	12-01-06	EPA approved proposed Phase 2 wetland sediment/surface water locations in GRG's 12-01-06 e-mail.
	Letter	11-01-07	GRG provided Phase 1 and 2 wetland sediment data and proposed Phase 3 investigation.
	Letter	12-13-07	EPA approved Phase 3 wetland sediment investigation proposed in GRG's 11-01-7 letter.
	Letter	2-12-08	GRG provided Phase 3 wetland sediment data and proposed Phase 4 investigation.
	Letter	3-18-08	EPA approved (with modifications) Phase 4 wetland sediment investigation proposed in GRG's 2-12-08 letter and requested resubmittal of revised letter.
	Letter	04-14-08	GRG resubmitted Phase 3 wetland sediment data and proposed Phase 4 investigation incorporating modifications from EPA 3-18-08 letter.
	Letter	09-08-08	GRG provided validated Phase 4 data.
Wetlands – Surface Water	Letter	11-28-06	GRG provided figure with proposed Phase 2 wetland sediment/surface water sample locations.
	e-mail	12-01-06	GRG provided revised figure with proposed Phase 2 wetland sediment/surface water sample locations.
	e-mail	12-01-06	EPA approved proposed Phase 2 wetland sediment/surface water locations in GRG's 12-01-06 e-mail.
	e-mail	05-10-07	GRG provided Phase 1 and Phase 2 wetland surface water data with conclusion that no additional wetland surface water sampling was needed.
Ponds - Sediment	Letter	11-13-06	GRG provided validated data for pond sediment samples.
Ponds – Surface Water	Letter	11-13-06	GRG provided validated data for pond surface water samples.

TABLE 2 – REMEDIAL INVESTIGATION COMMUNICATION SUMMARY

Investigation	Communication Method	Date	Description
Groundwater	Letter	01-19-07	GRG provided Phase 1 data and proposed Phase 2 investigation (including five additional Zone A monitoring wells and five Zone B monitoring wells).
	Letter	03-01-07	EPA approved (with modifications) proposed Phase 2 investigation in GRG's 1-19-07 letter. Modifications included addition of two more Zone A wells.
	Letter	06-13-07	GRG documented EPA concurrence (on 5-30-07) that proposed Zone B monitoring wells NCMW23B and OMW26B not be installed because soil borings indicated that Zone B was not present at these locations.
	Letter	10-12-07	GRG provided Phase 2 data and proposed Phase 3 investigation (including one additional Zone B monitoring well).
	Letter	11-08-07	EPA approved (with modifications) proposed Phase 3 investigation in GRG's 10-12-07 letter and requested resubmittal of revised letter.
	Letter	11-30-07	GRG resubmitted Phase 2 data and proposed Phase 3 investigations incorporating modifications from EPA 11-08-07 letter.
	Letter	01-15-08	GRG provided Phase 3 data and proposed Phase 4 investigation (including one additional Zone B monitoring well, two Zone C piezometers, and one Zone C monitoring well).
	Telephone Conversation	01-28-08	EPA requested that proposed Phase 4 investigations be modified to include use of Membrane Interface Probe during Cone Penetrometer (CPT) advancement and installation of four Zone C piezometers instead of two Zone C piezometers.
	Letter	02-11-08	GRG provided Phase 3 data and revised proposal for Phase 4 investigation (including one additional Zone B monitoring well, four Zone C piezometers, and one Zone C monitoring well).
	Letter	03-18-08	EPA approved proposed Phase 4 investigation in GRG's 2-11-08 letter.
	e-mail	06-18-08	GRG proposed deep soil boring location.
	e-mail	06-18-08	EPA approved proposed deep soil boring location.
	Telephone conversation	07-16-08	GRG provided preliminary Phase 4 data to EPA.
	e-mail	07-17-08	GRG proposed resampling of well NE4MW32C and sampling of four Zone C CPT piezometers.
	e-mail	07-23-08	Per EPA request, GRG provided description of procedures to be used for sampling CPT piezometers.
	e-mail	07-23-08	EPA approved proposed sampling procedures for CPT piezometers.

TABLE 2 – REMEDIAL INVESTIGATION COMMUNICATION SUMMARY

Investigation	Communication Method	Date	Description
Groundwater (continued)	Letter	08-12-08	GRG provided unvalidated Phase 4 data to EPA.
	e-mail	08-19-08	GRG provided preliminary data for NE4MW32C and four Zone C CPT piezometers.
	e-mail	09-03-08	GRG proposed resampling of well NE4MW32C.
	Letter	09-10-08	EPA approved proposed resampling of well NE4MW32C.
	e-mail	10-27-08	GRG provided updated Zone C data and proposed resampling of well NE4MW32C and installation of additional Zone C CPT piezometer.
	Letter	11-12-08	GRG provided validated Phase 4 data and proposed Phase 5 investigation (resampling of well NE4MW32C and installation of additional Zone C CPT piezometer).
	Letter	12-18-08	EPA approved proposed Phase 5 investigation.
	Letter	02-09-09	GRG provided Phase 5 data.

Notes:
[1]Gulfco Restoration Group (GRG) refers to LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy) and The Dow Chemical Company (Dow), collectively.

TABLE 3 - MONITORING WELL/PIEZOMETER CONSTRUCTION INFORMATION

Well Name	Top of Casing (TOC) Elevation (Feet Above Mean Sea Level)(1)	Ground Surface Elevation (Feet Above Mean Sea Level)(1)	Total Boring Depth (Feet below Ground Surface)	Monitoring Well/Piezometer Screened Interval (Feet below Ground Surface)
Zone A				
ND2MW01	5.09	1.9	17.0	5.0-15.0
ND3MW02	6.41	3.7	22.0	11.5-21.5
ND4MW03	6.20	3.2	20.0	7.5-17.5
NE1MW04	4.90	2.1	17.0	6.5-16.5
NE3MW05	6.53	3.3	22.0	5-15.5
NF2MW06	5.35	2.2	20.0	6.0-16.0
SB4MW07	7.57	4.6	20.0	9.5-19.5
SE1MW08	7.54	4.4	20.0	8.5-18.5
SE6MW09	7.66	4.7	20.0	9.5-19.5
SF5MW10	8.01	5.0	20.0	9.0-19.0
SF6MW11	8.11	5.0	20.0	8.0-18.0
SF7MW12	7.96	4.7	20.0	8.5-18.5
SG2MW13	7.71	4.5	22.0	6.0-16.0
SH7MW14	8.10	5.2	22.0	10.0-20.0
SJ1MW15	5.61	2.5	25.0	10.0-20.0
SJ7MW16	7.19	4.7	25.0	12.5-22.5
SL8MW17	5.87	2.9	33.0	15.0-25.0
NB4MW18	4.96	2.5	20.0	7.5-17.5
NG3MW19	5.08	2.2	17.0	4.0-13.5
OMW20	4.88	1.6	17.5	6.0-15.5
OMW21	5.73	2.4	20.0	8.0-18.0
SA4MW22	7.79	5.5	15.0	4.5-14.5
NC2MW28	4.76	1.8	15.0	5-14.5
ND3MW29	5.33	2.9	17.5	7.0-17.0
NB4PZ01	NM(2)	2.3	22.0	9.0-19.0
NC3PZ02	NM	2.9	28.0	12.5-22.5
ND1PZ03	NM	2.2	18.0	5.5-15.5
ND3PZ04	NM	2.4	20.0	7.0-17.0
NF1PZ05	NM	2.2	18.0	8.0-18.0
NF3PZ06	NM	2.5	16.0	3-13
SA4PZ07	NM	5.4	24.0	12-22
SD3PZ08	NM	5.6	28.0	12-22

TABLE 3 - MONITORING WELL/PIEZOMETER CONSTRUCTION INFORMATION

Well Name	Top of Casing (TOC) Elevation (Feet Above Mean Sea Level)(1)	Ground Surface Elevation (Feet Above Mean Sea Level)(1)	Total Boring Depth (Feet below Ground Surface)	Monitoring Well/Piezometer Screened Interval (Feet below Ground Surface)
Zone B				
NC2B23B	NA(3)	2.0	40.0	NA
ND4MW24B	5.70	3.5	34.0	21.5-26.5
NG3MW25B	4.91	2.2	35.0	17.0-27.0
OB26B	NA	1.6	40.0	NA
OMW27B	5.45	2.8	30.0	24.5-27
NE3MW30B	6.70	3.5	35.5	25-35
NE4MW31B	6.01	3.0	45.0	18-28
Zone C				
NG3CPT1	5.79	2.1	73.0	63-73
NE4CPT2	6.77	3.2	73.0	63-73
NC2CPT3	5.36	1.7	69.0	59-69
OCPT4	6.38	2.7	73.0	63-73
OCPT5	5.32	1.5	80.0	59-64,69-74
NE4MW32C	6.31	3.2	80.0	64-74

Notes:
(1) Mean Sea Level - NGVD 1929.
(2) NM = Not measured. Temporary piezometer at this location.
(3) NA = Not Applicable. Well not constructed in this boring - Zone B not present.

TABLE 4 - FORMER SURFACE IMPOUNDMENTS CAP MATERIAL DATA

Boring Location	Cap Material Description(1)	Observed Cap Thickness (ft)	Liquid Limit(2) (%)	Plastic Limit(2) (%)	Plasticity Index(2) (%)	Percent Passing # 200 Sieve(3) (%)	Moisture Content(4) (%)	Vertical Hydraulic Conductivity(5) (cm/sec)
ND1GT01	Sandy Lean Clay	2.9	48	16	32	70	20	3.5×10^{-8}
ND2GT02	Lean Clay with Sand	>3.5	49	14	35	84	23	1.4×10^{-8}
NE1GT03	Lean Clay with Sand	2.5	49	13	35	74	19	5.0×10^{-9}
NE2GT04	Fat Clay	3.6	58	15	43	88	26	5.9×10^{-9}
TCEQ Technical Guideline No. 3 Recommended Value/Range			--	--	10 - 35	>20	--	$<1.0 \times 10^{-7}$

Notes:
1. Crushed oyster shell surface observed above clay cap at all four boring locations.
2. ASTM Method D 4318
3. ASTM Method D 1140
4. ASTM Method D 2216
5. US Army Corps of Engineers, Engineering Manual Method 1110-2-1906

TABLE 5 - SEDIMENT GRAIN SIZE DISTRIBUTION DATA

Sample ID	Sample Date	Grain Size Distribution Gravel (%)[1]	Sand (%)[2]	Fines (%)[3]	Location Notes
Site Intracoastal Waterway (ICWW) Sediment Samples					
IWSE-01-001 (0-0.5)	6/26/2006	0	32.6	67.4	Along edge of ICWW
IWSE-02-002 (0-0.5)	6/26/2006	0	42.6	57.4	Within barge slip at Site
IWSE-03-003 (0-0.5)	6/26/2006	0.3	51	48.7	Within barge slip at Site
IWSE-03-034 (0-0.5)	6/26/2006	0.6	48.2	51.2	Within barge slip at Site
IWSE-04-004 (0-0.5)	6/26/2006	0	15.3	84.7	Within barge slip at Site
IWSE-05-005 (0-0.5)	6/26/2006	12.8	29.4	57.8	Along edge of ICWW
IWSE-06-006 (0-0.5)	6/26/2006	3.1	4.2	92.7	Within barge slip at Site
IWSE-07-007 (0-0.5)	6/26/2006	0	25.6	74.4	Within barge slip at Site
IWSE-08-008 (0-0.5)	6/26/2006	0	32.1	67.9	Within barge slip at Site
IWSE-09-009 (0-0.5)	6/26/2006	0	11.9	88.1	Within barge slip at Site
IWSE-10-010 (0-0.5)	6/26/2006	0	24.1	75.9	Within barge slip at Site
IWSE-11-011 (0-0.5)	6/26/2006	0	36.3	63.7	Along edge of ICWW
IWSE-12-012 (0-0.5)	6/26/2006	0	36.1	63.9	Along edge of ICWW
IWSE-13-013 (0-0.5)	6/26/2006	0	43	57	Along edge of ICWW
IWSE-14-014 (0-0.5)	6/26/2006	0	45.7	54.3	Along edge of ICWW
IWSE-15-015 (0-0.5)	6/26/2006	0	45.6	54.4	Along edge of ICWW
IWSE-16-016 (0-0.5)	6/26/2006	0	36.6	63.4	Along edge of ICWW
Background Intracoasatal Waterway Sediment Samples					
IWSE-21-021 (0-0.5)	6/27/2006	1.8	7.6	90.6	Background area within ICWW
IWSE-22-022 (0-0.5)	6/27/2006	11.9	30.9	57.2	Background area within ICWW
IWSE-23-023 (0-0.5)	6/27/2006	7.2	17.4	75.4	Background area within ICWW
IWSE-24-024 (0-0.5)	6/27/2006	0.1	49.2	50.7	Background area within ICWW
IWSE-25-025 (0-0.5)	6/27/2006	0.9	31.5	67.6	Background area within ICWW
IWSE-25-044 (0-0.5)	6/27/2006	0.1	38.7	61.2	Background area within ICWW
IWSE-26-026 (0-0.5)	6/27/2006	0	39.7	60.3	Background area within ICWW
IWSE-27-027 (0-0.5)	6/27/2006	1.4	9	89.6	Background area within ICWW
IWSE-28-028 (0-0.5)	6/27/2006	0	6.2	93.8	Background area within ICWW
IWSE-29-029 (0-0.5)	6/27/2006	0	35.8	64.2	Background area within ICWW
Intracoastal Waterway Summary Analysis					
Background Area Samples - Mean	NA	2.3	26.6	71.1	
Site Barge Slip Samples - Mean	NA	0.4	28.3	71.2	
Site Samples Adjacent to Channel - Mean	NA	1.6	38.2	60.2	

TABLE 5 - SEDIMENT GRAIN SIZE DISTRIBUTION DATA

Sample ID	Sample Date	Grain Size Distribution			Location Notes
		Gravel (%)[1]	Sand (%)[2]	Fines (%)[3]	
North Area Wetland Sediment Samples					
NG3SE16-016-(0-0.5)	7/14/2006	0	17.3	82.7	North Area Wetlands Sediment Sample
NG1SE14-014-(0-0.5)	7/14/2006	0	12.1	87.9	North Area Wetlands Sediment Sample
NF4SE13-013-(0-0.5)	7/14/2006	13.6	39.5	46.9	North Area Wetlands Sediment Sample
NA1SE01-001-(0-0.5)	7/14/2006	1.2	21.2	77.6	North Area Wetlands Sediment Sample
NB1SE05-005-(0-0.5)	7/14/2006	1.7	14.2	84.1	North Area Wetlands Sediment Sample
NB2SE06-006-(0-0.5)	7/14/2006	0.2	23.3	76.5	North Area Wetlands Sediment Sample
NC1SE09-009-(0-0.5)	7/14/2006	0	8.9	91.1	North Area Wetlands Sediment Sample
NC2SE10-010-(0-0.5)	7/14/2006	0.7	9.7	89.6	North Area Wetlands Sediment Sample
NC3SE11-011-(0-0.5)	7/14/2006	0.3	38.2	61.5	North Area Wetlands Sediment Sample
NA2SE02-002-(0-0.5)	7/14/2006	0.6	22.6	76.8	North Area Wetlands Sediment Sample
NA3SE03-003-(0-0.5)	7/14/2006	0	7.8	92.2	North Area Wetlands Sediment Sample
NA4SE04-004-(0-0.5)	7/14/2006	0	12.4	87.6	North Area Wetlands Sediment Sample
NB3SE07-007-(0-0.5)	7/14/2006	0	8.9	91.1	North Area Wetlands Sediment Sample
NG4SE17-017-(0-0.5)	7/14/2006	0	12.1	87.9	North Area Wetlands Sediment Sample
NG2SE15-015-(0-0.5)	7/14/2006	0	8.9	91.1	North Area Wetlands Sediment Sample
NC4SE12-012-(0-0.5)	7/14/2006	0	38.2	61.8	North Area Wetlands Sediment Sample
NB4SE08-008-(0-0.5)	7/14/2006	1.5	51.9	46.6	North Area Wetlands Sediment Sample
NB4SE08-024(1-2)	8/2/2006	0	8.5	91.5	North Area Wetlands Sediment Sample
NA4SE04-021(1-2)	8/2/2006	0	5.8	94.2	North Area Wetlands Sediment Sample
NA3SE03-020(1-2)	8/2/2006	0	5.9	94.1	North Area Wetlands Sediment Sample
NB3SE07-023(1-2)	8/2/2006	0	5.8	94.2	North Area Wetlands Sediment Sample
NB2SE06-022(1-2)	8/2/2006	0	6.4	93.6	North Area Wetlands Sediment Sample
NC3SE11-027(1-2)	8/2/2006	0	7.1	92.9	North Area Wetlands Sediment Sample
NC3SE10-026(1-2)	8/2/2006	0	2.4	97.6	North Area Wetlands Sediment Sample
NC1SE09-025(1-2)	8/2/2006	0	2.1	97.9	North Area Wetlands Sediment Sample
NG3SE16-030-(1-2)	7/24/2006	0	12.1	87.9	North Area Wetlands Sediment Sample
NF4SE13-028-(1-2)	7/24/2006	13	28.7	58.3	North Area Wetlands Sediment Sample
2WSED1-001-(0-0.5)	12/6/2006	0	9.7	90.3	North Area Wetlands Sediment Sample
2WSED2-002-(0-0.5)	12/6/2006	0	21.1	78.9	North Area Wetlands Sediment Sample
2WSED3-003-(0-0.5)	12/6/2006	0	23.1	76.9	North Area Wetlands Sediment Sample
2WSED4-004-(0-0.5)	12/6/2006	0	25.7	74.3	North Area Wetlands Sediment Sample
2WSED5-005-(0-0.5)	12/6/2006	1.6	16.1	82.3	North Area Wetlands Sediment Sample
2WSED6-006-(0-0.5)	12/6/2006	0	9.8	90.2	North Area Wetlands Sediment Sample
2WSED7-007-(0-0.5)	12/6/2006	0	17.6	82.4	North Area Wetlands Sediment Sample
2WSED8-008-(0-0.5)	12/6/2006	0	10.3	89.7	North Area Wetlands Sediment Sample
2WSED9-009-(0-0.5)	12/6/2006	0	8.2	91.8	North Area Wetlands Sediment Sample
2WSED10-010-(0-0.5)	12/6/2006	0	8.5	91.5	North Area Wetlands Sediment Sample
2WSED11-011-(0-0.5)	12/6/2006	0	10.6	89.4	North Area Wetlands Sediment Sample
2WSED12-012-(0-0.5)	12/6/2006	0	9.6	90.4	North Area Wetlands Sediment Sample
2WSED13-013-(0-0.5)	12/6/2006	0	6.1	93.9	North Area Wetlands Sediment Sample
2WSED14-014-(0-0.5)	12/6/2006	0	5.6	94.4	North Area Wetlands Sediment Sample
2WSED15-015-(0-0.5)	12/6/2006	0	49.3	50.7	North Area Wetlands Sediment Sample
2WSED16-016-(0-0.5)	12/6/2006	1.1	22.8	76.1	North Area Wetlands Sediment Sample
2WSED17-017-(0-0.5)	12/6/2006	7.8	40	52.2	North Area Wetlands Sediment Sample
EWSED01	8/12/2010	6	14.7	82.8	North Area Wetlands Sediment Sample
EWSED02	8/12/2010	59.6	9.8	24.5	North Area Wetlands Sediment Sample
EWSED03	8/13/2010	55.6	12.4	30.1	North Area Wetlands Sediment Sample
EWSED04	8/13/2010	2.76	20.6	82	North Area Wetlands Sediment Sample
EWSED05	8/12/2010	3	28.1	66.2	North Area Wetlands Sediment Sample
EWSED07	8/13/2010	3.8	21.2	78	North Area Wetlands Sediment Sample
EWSED08	8/13/2010	24.8	19	58.9	North Area Wetlands Sediment Sample
EWSED09	8/13/2010	4.3	9.4	88.9	North Area Wetlands Sediment Sample
North Area Sediment Samples - Mean	NA	3.9	16.6	79.7	

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TABLE 5 - SEDIMENT GRAIN SIZE DISTRIBUTION DATA

Sample ID	Sample Date	Grain Size Distribution Gravel (%)[1]	Sand (%)[2]	Fines (%)[3]	Location Notes
Small Pond Sediment Samples					
SPSE01-001	7/14/2006	0	7.6	92.4	Small Pond Sediment Sample
SPSE02-002	7/14/2006	0	2.8	97.2	Small Pond Sediment Sample
SPSE03-003	7/14/2006	0	6.5	93.5	Small Pond Sediment Sample
EWSED06	8/12/2010	19.6	4.6	83.3	Small Pond Sediment Sample
Small Pond Sediment Samples - Mean	NA	4.9	5.4	91.6	
Fresh Water Pond Sediment Samples					
FWPSE01-001-(0-0.5)	8/2/2006	0	7.9	92.1	Fresh Water Pond Sediment Sample
FWPSE04-004-(0-0.5)	8/2/2006	0.5	5	94.5	Fresh Water Pond Sediment Sample
FWPSE02-002-(0-0.5)	8/2/2006	0	4	96	Fresh Water Pond Sediment Sample
FWPSE03-003-(0-0.5)	8/2/2006	0	4	96	Fresh Water Pond Sediment Sample
FWPSE05-005-(0-0.5)	8/2/2006	0	9.1	90.9	Fresh Water Pond Sediment Sample
Fresh Water Pond Sediment Samples - Mean	NA	0.1	6.0	93.9	

NOTES:

1. Percent Gravel = particle size 4.75-45 mm
2. Percent Sand = 0.075 to 4.75 mm
3. Percent Fines (silt and clay) = less than 0.075 mm
4. ICWW = Intracoastal Waterway

TABLE 6 - TOTAL ORGANIC CARBON CONCENTRATIONS IN SEDIMENT

Sample ID	Sample Date	Total Organic Carbon Concentration (mg/Kg)	Location Notes
Site Intracoastal Waterway (ICWW) Sediment Samples			
IWSE-01-001 (0-0.5)	6/26/2006	<146	Along edge of ICWW
IWSE-02-002 (0-0.5)	6/26/2006	7520	Within barge slip at Site
IWSE-03-003 (0-0.5)	6/26/2006	<146	Within barge slip at Site
IWSE-03-034 (0-0.5)	6/26/2006	<146	Within barge slip at Site
IWSE-04-004 (0-0.5)	6/26/2006	<146	Within barge slip at Site
IWSE-05-005 (0-0.5)	6/26/2006	<146	Along edge of ICWW
IWSE-06-006 (0-0.5)	6/26/2006	<146	Within barge slip at Site
IWSE-07-007 (0-0.5)	6/26/2006	<146	Within barge slip at Site
IWSE-08-008 (0-0.5)	6/26/2006	<146	Within barge slip at Site
IWSE-09-009 (0-0.5)	6/26/2006	<146	Within barge slip at Site
IWSE-10-010 (0-0.5)	6/26/2006	<146	Within barge slip at Site
IWSE-11-011 (0-0.5)	6/26/2006	<146	Along edge of ICWW
IWSE-12-012 (0-0.5)	6/26/2006	<146	Along edge of ICWW
IWSE-13-013 (0-0.5)	6/26/2006	<146	Along edge of ICWW
IWSE-14-014 (0-0.5)	6/26/2006	<146	Along edge of ICWW
IWSE-15-015 (0-0.5)	6/26/2006	<146	Along edge of ICWW
IWSE-16-016 (0-0.5)	6/26/2006	<146	Along edge of ICWW
EIWSED01	8/18/2010	4130	Along edge of ICWW
EIWSED02	8/18/2010	7200	Within barge slip at Site
EIWSED03	8/18/2010	6320	Within barge slip at Site
EIWSED04	8/21/2010	5480	Within barge slip at Site
EIWSED05	8/18/2010	6820	Within barge slip at Site
Background Intracoastal Waterway Sediment Samples			
IWSE-21-021 (0-0.5)	6/27/2006	8030 J	Background area within ICWW
IWSE-22-022 (0-0.5)	6/27/2006	<146 J	Background area within ICWW
IWSE-23-023 (0-0.5)	6/27/2006	6720 J	Background area within ICWW
IWSE-24-024 (0-0.5)	6/27/2006	<146 J	Background area within ICWW
IWSE-25-025 (0-0.5)	6/27/2006	<146 J	Background area within ICWW
IWSE-25-044 (0-0.5)	6/27/2006	6520 J	Background area within ICWW
IWSE-26-026 (0-0.5)	6/27/2006	<146 J	Background area within ICWW
IWSE-27-027 (0-0.5)	6/27/2006	8010 J	Background area within ICWW
IWSE-28-028 (0-0.5)	6/27/2006	<146 J	Background area within ICWW
IWSE-29-029 (0-0.5)	6/27/2006	<146 J	Background area within ICWW
EIWSED06	8/18/2010	6060	Background area within ICWW
EIWSED07	8/18/2010	5090	Background area within ICWW

TABLE 6 - TOTAL ORGANIC CARBON CONCENTRATIONS IN SEDIMENT

Sample ID	Sample Date	Total Organic Carbon Concentration (mg/Kg)	Location Notes
North Area Wetland Sediment Samples			
NA1SE01-001-(0-0.5)	7/14/2006	24300	North Area Wetlands Sediment Sample
NA2SE02-002-(0-0.5)	7/14/2006	27200	North Area Wetlands Sediment Sample
NA3SE03-003-(0-0.5)	7/14/2006	13500	North Area Wetlands Sediment Sample
NA3SE03-020 (1-2)	8/2/2006	<146	North Area Wetlands Sediment Sample
NA4SE04-004-(0-0.5)	7/14/2006	18700	North Area Wetlands Sediment Sample
NA4SE04-021(1-2)	8/2/2006	<146	North Area Wetlands Sediment Sample
NB1SE05-005-(0-0.5)	7/14/2006	17600	North Area Wetlands Sediment Sample
NB2SE06-006-(0-0.5)	7/14/2006	<146	North Area Wetlands Sediment Sample
NB2SE06-022(1-2)	8/2/2006	<146	North Area Wetlands Sediment Sample
NB3SE07-007-(0-0.5)	7/14/2006	<146	North Area Wetlands Sediment Sample
NB3SE07-023(1-2)	8/2/2006	<146	North Area Wetlands Sediment Sample
NB4SE08-008-(0-0.5)	7/14/2006	<146	North Area Wetlands Sediment Sample
NB4SE08-024(1-2)	8/2/2006	<146	North Area Wetlands Sediment Sample
NC1SE09-009-(0-0.5)	7/14/2006	<146	North Area Wetlands Sediment Sample
NC1SE09-025(1-2)	8/2/2006	<146	North Area Wetlands Sediment Sample
NC2SE10-010-(0-0.5)	7/14/2006	<146	North Area Wetlands Sediment Sample
NC3SE10-026 (1-2)	8/2/2006	<146	North Area Wetlands Sediment Sample
NC3SE11-011-(0-0.5)	7/14/2006	<146	North Area Wetlands Sediment Sample
NC3SE11-027(1-2)	8/2/2006	<146	North Area Wetlands Sediment Sample
NC4SE12-012-(0-0.5)	7/14/2006	<146	North Area Wetlands Sediment Sample
NF4SE13-013-(0-0.5)	7/14/2006	<146	North Area Wetlands Sediment Sample
NF4SE13-028-(1-2)	7/24/2006	<146	North Area Wetlands Sediment Sample
NG1SE14-014-(0-0.5)	7/14/2006	17400	North Area Wetlands Sediment Sample
NG2SE15-015 (0-0.5)	7/14/2006	8770	North Area Wetlands Sediment Sample
NG3SE16-030-(1-2)	7/24/2006	<146	North Area Wetlands Sediment Sample
NG4SE17-017 (0-0.5)	7/14/2006	6020	North Area Wetlands Sediment Sample
2WSED1-001 (0-0.5)	12/6/2006	<146 J	North Area Wetlands Sediment Sample
2WSED2-002 (0-0.5)	12/6/2006	28300 J	North Area Wetlands Sediment Sample
2WSED3-003 (0-0.5)	12/6/2006	<146 J	North Area Wetlands Sediment Sample
2WSED4-004 (0-0.5)	12/6/2006	50300 J	North Area Wetlands Sediment Sample
2WSED5-005 (0-0.5)	12/6/2006	27900 J	North Area Wetlands Sediment Sample
2WSED6-006 (0-0.5)	12/6/2006	9200 J	North Area Wetlands Sediment Sample
2WSED7-007 (0-0.5)	12/6/2006	26500 J	North Area Wetlands Sediment Sample
2WSED8-008 (0-0.5)	12/6/2006	8450 J	North Area Wetlands Sediment Sample
2WSED8 (1-2)	6/4/2008	6660 J	North Area Wetlands Sediment Sample
2WSED9-009 (0-0.5)	12/6/2006	7210 J	North Area Wetlands Sediment Sample
2WSED9 (1-2)	12/19/2007	<146	North Area Wetlands Sediment Sample
2WSED9 (1-2) duplicate	12/19/2007	<146	North Area Wetlands Sediment Sample
2WSED10-010 (0-0.5)	12/6/2006	13000 J	North Area Wetlands Sediment Sample
2WSED10 (1-2)	6/4/2008	22700 J	North Area Wetlands Sediment Sample
2WSED11-011 (0-0.5)	12/6/2006	33300 J	North Area Wetlands Sediment Sample
2WSED12-012 (0-0.5)	12/6/2006	33900 J	North Area Wetlands Sediment Sample
2WSED13-013 (0-0.5)	12/6/2006	<146 J	North Area Wetlands Sediment Sample
2WSED14-014 (0-0.5)	12/6/2006	<146 J	North Area Wetlands Sediment Sample
2WSED15-015 (0-0.5)	12/6/2006	53600 J	North Area Wetlands Sediment Sample
2WSED16-016 (0-0.5)	12/6/2006	12500 J	North Area Wetlands Sediment Sample
2WSED17-017 (0-0.5)	12/6/2006	<146 J	North Area Wetlands Sediment Sample
4WSED2 (0-0.5)	6/4/2008	21500 J	North Area Wetlands Sediment Sample
4WSED3 (0-0.5)	6/4/2008	16300 J	North Area Wetlands Sediment Sample

TABLE 6 - TOTAL ORGANIC CARBON CONCENTRATIONS IN SEDIMENT

Sample ID	Sample Date	Total Organic Carbon Concentration (mg/Kg)	Location Notes
North Area Wetland Sediment Samples (continued)			
EWSED01	8/12/2010	59400	North Area Wetlands Sediment Sample
EWSED02	8/12/2010	24100	North Area Wetlands Sediment Sample
EWSED03	8/13/2010	18200	North Area Wetlands Sediment Sample
EWSED04	8/13/2010	16700	North Area Wetlands Sediment Sample
EWSED05	8/12/2010	18100	North Area Wetlands Sediment Sample
EWSED07	8/13/2010	23900	North Area Wetlands Sediment Sample
EWSED08	8/13/2010	46800	North Area Wetlands Sediment Sample
EWSED09	8/13/2010	11200	North Area Wetlands Sediment Sample
Small Pond Sediment Samples			
SPSE01-001	7/14/2006	<146	Small Pond Sediment Sample
SPSE02-002	7/14/2006	8320	Small Pond Sediment Sample
SPSE03-003	7/14/2006	4240	Small Pond Sediment Sample
EWSED06	8/12/2010	21500	Small Pond Sediment Sample
Fresh Water Pond Sediment Samples			
FWPSE01-001-(0-0.5)	8/2/2006	<146	Fresh Water Pond Sediment Sample
FWPSE04-004-(0-0.5)	8/2/2006	<146	Fresh Water Pond Sediment Sample
FWPSE02-002-(0-0.5)	8/2/2006	<146	Fresh Water Pond Sediment Sample
FWPSE03-003-(0-0.5)	8/2/2006	<146	Fresh Water Pond Sediment Sample
FWPSE05-005-(0-0.5)	8/2/2006	<146	Fresh Water Pond Sediment Sample

NOTES:
1. J = Estimated value.

TABLE 7 - WATER LEVEL MEASUREMENTS

Well ID	Ground Surface Elevation (ft AMSL[2])	Total Boring Depth (ft BGS[3])	Screened Interval (ft BGS[3])	Date	TOC[1] Elevation (ft AMSL[2])	Depth to Water (ft BTOC[4])	Water Elevation (ft AMSL[2])
ND2MW01	1.9	17.0	5.0-15.0	8/4/2006	5.09	3.94	1.15
				10/5/2006	5.09	3.95	1.14
				6/6/2007	5.09	4.23	0.86
				9/6/2007	5.09	4.02	1.07
				11/7/2007	5.09	4.31	0.78
				12/3/2007	5.09	4.13	0.96
				6/17/2008	5.09	5.99	-0.90
ND3MW02	3.7	22.0	11.5-21.5	8/4/2006	6.41	4.21	2.20
				10/5/2006	6.41	4.27	2.14
				6/6/2007	6.41	4.59	1.82
				9/6/2007	6.41	4.27	2.14
				11/7/2007	6.41	4.93	1.48
				12/3/2007	6.41	4.46	1.95
				6/17/2008	6.41	6.67	-0.26
ND4MW03	3.2	20.0	7.5-17.5	8/4/2006	6.20	4.11	2.09
				10/5/2006	6.20	4.13	2.07
				6/6/2007	6.20	4.42	1.78
				9/6/2007	6.20	3.84	2.36
				11/7/2007	6.20	4.47	1.73
				12/3/2007	6.20	3.73	2.47
				6/17/2008	6.20	6.31	-0.11
NE1MW04	2.1	17.0	6.5-16.5	8/4/2006	4.90	4.81	0.09
				10/5/2006	4.90	3.87	1.03
				6/6/2007	4.90	4.12	0.78
				9/6/2007	4.90	3.93	0.97
				11/7/2007	4.90	3.62	1.28
				12/3/2007	4.90	3.47	1.43
				6/17/2008	4.90	5.43	-0.53
NE3MW05	3.3	22.0	5-15.5	8/4/2006	6.53	3.60	2.93
				10/5/2006	6.53	3.66	2.87
				6/6/2007	6.53	3.92	2.61
				9/6/2007	6.53	3.63	2.90
				11/7/2007	6.53	5.21	1.32
				12/3/2007	6.53	5.03	1.50
				6/17/2008	6.53	6.33	0.20
NF2MW06	2.2	20.0	6.0-16.0	8/4/2006	5.35	3.71	1.64
				10/5/2006	5.35	3.79	1.56
				6/6/2007	5.35	4.06	1.29
				9/6/2007	5.35	3.89	1.46
				11/7/2007	5.35	3.57	1.78
				12/3/2007	5.35	3.27	2.08
				6/17/2008	5.35	4.93	0.42
SB4MW07	4.6	20.0	9.5-19.5	8/4/2006	7.57	6.60	0.97
				10/5/2006	7.57	5.65	1.92
				6/6/2007	7.57	5.38	2.19
				9/6/2007	7.57	5.57	2.00
				11/7/2007	7.57	6.06	1.51
				12/3/2007	7.57	6.14	1.43
				6/17/2008	7.57	5.92	1.65
SE1MW08	4.4	20.0	8.5-18.5	8/4/2006	7.54	5.19	2.35
				10/5/2006	7.54	5.36	2.18
				6/6/2007	7.54	5.37	2.17
				9/6/2007	7.54	5.31	2.23
				11/7/2007	7.54	6.03	1.51
				12/3/2007	7.54	5.21	2.33
				6/17/2008	7.54	6.81	0.73

TABLE 7 - WATER LEVEL MEASUREMENTS

Well ID	Ground Surface Elevation (ft AMSL[2])	Total Boring Depth (ft BGS[3])	Screened Interval (ft BGS[3])	Date	TOC[1] Elevation (ft AMSL[2])	Depth to Water (ft BTOC[4])	Water Elevation (ft AMSL[2])
SE6MW09	4.7	20.0	9.5-19.5	8/4/2006	7.66	6.04	1.62
				10/5/2006	7.66	5.84	1.82
				6/6/2007	7.66	5.82	1.84
				9/6/2007	7.66	5.72	1.94
				11/7/2007	7.66	6.09	1.57
				12/3/2007	7.66	5.74	1.92
				6/17/2008	7.66	6.43	1.23
SF5MW10	5.0	20.0	9.0-19.0	8/4/2006	8.01	5.88	2.13
				10/5/2006	8.01	6.01	2.00
				6/6/2007	8.01	5.79	2.22
				9/6/2007	8.01	5.75	2.26
				11/7/2007	8.01	5.97	2.04
				12/3/2007	8.01	6.01	2.00
				6/17/2008	8.01	7.03	0.98
SF6MW11	5.0	20.0	8.0-18.0	8/4/2006	8.11	6.62	1.49
				10/5/2006	8.11	6.43	1.68
				6/6/2007	8.11	6.37	1.74
				9/6/2007	8.11	6.34	1.77
				11/7/2007	8.11	6.71	1.40
				12/3/2007	8.11	6.39	1.72
				6/17/2008	8.11	6.97	1.14
SF7MW12	4.7	20.0	8.5-18.5	8/4/2006	7.96	6.41	1.55
				10/5/2006	7.96	6.15	1.81
				6/6/2007	7.96	6.52	1.44
				9/6/2007	7.96	6.59	1.37
				11/7/2007	7.96	6.64	1.32
				12/3/2007	7.96	6.44	1.52
				6/17/2008	7.96	6.76	1.20
SG2MW13	4.5	22.0	6.0-16.0	8/4/2006	7.71	5.65	2.06
				10/5/2006	7.71	5.96	1.75
				6/6/2007	7.71	5.62	2.09
				9/6/2007	7.71	5.56	2.15
				11/7/2007	7.71	6.68	1.03
				12/3/2007	7.71	6.07	1.64
				6/17/2008	7.71	7.18	0.53
SH7MW14	5.2	22.0	10.0-20.0	8/4/2006	8.10	6.41	1.69
				10/5/2006	8.10	6.36	1.74
				6/6/2007	8.10	6.02	2.08
				9/6/2007	8.10	6.21	1.89
				11/7/2007	8.10	6.74	1.36
				12/3/2007	8.10	6.43	1.67
				6/17/2008	8.10	6.84	1.26
SJ1MW15	2.5	25.0	10.0-20.0	8/4/2006	5.61	4.17	1.44
				10/5/2006	5.61	4.35	1.26
				6/6/2007	5.61	4.09	1.52
				9/6/2007	5.61	3.47	2.14
				11/7/2007	5.61	3.58	2.03
				12/3/2007	5.61	3.47	2.14
				6/17/2008	5.61	5.47	0.14
SJ7MW16	4.7	25.0	12.5-22.5	8/4/2006	7.19	5.81	1.38
				10/5/2006	7.19	5.49	1.70
				6/6/2007	7.19	5.16	2.03
				9/6/2007	7.19	5.23	1.96
				11/7/2007	7.19	5.88	1.31
				12/3/2007	7.19	6.51	0.68
				6/17/2008	7.19	5.68	1.51

TABLE 7 - WATER LEVEL MEASUREMENTS

Well ID	Ground Surface Elevation (ft AMSL[2])	Total Boring Depth (ft BGS[3])	Screened Interval (ft BGS[3])	Date	TOC[1] Elevation (ft AMSL[2])	Depth to Water (ft BTOC[4])	Water Elevation (ft AMSL[2])
SL8MW17	2.9	33.0	15.0-25.0	8/4/2006	5.87	4.51	1.36
				10/5/2006	5.87	4.21	1.66
				6/6/2007	5.87	3.93	1.94
				9/6/2007	5.87	4.07	1.80
				11/7/2007	5.87	4.43	1.44
				12/3/2007	5.87	4.81	1.06
				6/17/2008	5.87	4.51	1.36
NB4MW18	2.5	20.0	7.5-17.5	6/6/2007	4.96	16.32	-11.36
				9/6/2007	4.96	3.17	1.79
				11/7/2007	4.96	4.19	0.77
				12/3/2007	4.96	3.68	1.28
				6/17/2008	4.96	5.89	-0.93
NG3MW19	2.2	17.0	4.0-13.5	6/6/2007	5.08	3.58	1.50
				9/6/2007	5.08	3.29	1.79
				11/7/2007	5.08	3.77	1.31
				12/3/2007	5.08	3.29	1.79
				6/17/2008	5.08	4.38	0.70
OMW20	1.6	17.5	6.0-15.5	6/6/2007	4.88	4.16	0.72
				9/6/2007	4.88	3.76	1.12
				11/7/2007	4.88	3.01	1.87
				12/3/2007	4.88	2.84	2.04
				6/17/2008	4.88	4.16	0.72
OMW21	2.4	20.0	8.0-18.0	6/6/2007	5.73	4.17	1.56
				9/6/2007	5.73	3.96	1.77
				11/7/2007	5.73	5.07	0.66
				12/3/2007	5.73	4.86	0.87
				6/17/2008	5.73	6.12	-0.39
SA4MW22	5.5	15.0	4.5-14.5	6/6/2007	7.79	6.27	1.52
				9/6/2007	7.79	6.34	1.45
				11/7/2007	7.79	6.57	1.22
				12/3/2007	7.79	6.72	1.07
				6/17/2008	7.79	6.86	0.93
ND4MW24B	3.5	34.0	21.5-26.5	6/6/2007	5.70	3.81	1.89
				9/6/2007	5.70	3.41	2.29
				11/7/2007	5.70	3.78	1.92
				12/3/2007	5.70	3.32	2.38
				6/17/2008	5.70	5.48	0.22
				7/30/2008	5.70	4.22	1.48
NG3MW25B	2.2	35.0	17.0-27.0	6/6/2007	4.91	3.17	1.74
				9/6/2007	4.91	3.01	1.90
				11/7/2007	4.91	3.15	1.76
				12/3/2007	4.91	2.94	1.97
				6/17/2008	4.91	3.69	1.22
				7/30/2008	4.91	3.26	1.65
OMW27B	2.8	30.0	24.5-27	6/6/2007	5.45	3.26	2.19
				9/6/2007	5.45	3.04	2.41
				11/7/2007	5.45	4.34	1.11
				12/3/2007	5.45	4.17	1.28
				6/17/2008	5.45	5.47	-0.02
				7/30/2008	5.45	4.27	1.18
NC2MW28	1.8	15.0	5-14.5	6/6/2007	4.76	2.83	1.93
				9/6/2007	4.76	2.42	2.34
				11/7/2007	4.76	2.86	1.90
				12/3/2007	4.76	2.51	2.25
				6/17/2008	4.76	4.27	0.49

TABLE 7 - WATER LEVEL MEASUREMENTS

Well ID	Ground Surface Elevation (ft AMSL[2])	Total Boring Depth (ft BGS[3])	Screened Interval (ft BGS[3])	Date	TOC[1] Elevation (ft AMSL[2])	Depth to Water (ft BTOC[4])	Water Elevation (ft AMSL[2])
ND3MW29	2.9	17.5	7.0-17.0	6/6/2007	5.33	3.91	1.42
				9/6/2007	5.33	3.58	1.75
				11/7/2007	5.33	4.38	0.95
				12/3/2007	5.33	3.27	2.06
				6/17/2008	5.33	5.63	-0.30
NE3MW30B	3.5	35.5	25.0-35.0	12/3/2007	6.70	4.78	1.92
				6/17/2008	6.70	NM	NM
				7/30/2008	6.70	5.08	1.62
NE4MW31B	3.0	45.0	18.0-28.0	6/17/2008	6.01	5.04	0.97
				7/30/2008	6.01	4.59	1.42
NE4MW32C	3.2	80.0	64.0-74.0	6/17/2008	6.31	8.62	-2.31
				7/30/2008	6.31	7.29	-0.98
				9/29/2008	6.31	7.48	-1.17
				1/13/2009	6.31	7.22	-0.91
NG3CPT1	2.1	73.0	63.0-73.0	6/9/2008	5.79	9.82	-4.03
				6/17/2008	5.79	9.47	-3.68
				7/30/2008	5.79	9.41	-3.62
				9/29/2008	5.79	6.09	-0.30
				1/13/2009	5.79	6.93	-1.14
NE4CPT2	3.2	73.0	63.0-73.0	6/9/2008	6.77	9.99	-3.22
				6/17/2008	6.77	10.32	-3.55
				7/30/2008	6.77	10.31	-3.54
				9/29/2008	6.77	9.88	-3.11
				1/13/2009	6.77	9.86	-3.09
NC2CPT3	1.7	69.0	59.0-69.0	6/9/2008	5.36	11.39	-6.03
				6/17/2008	5.36	11.48	-6.12
				7/30/2008	5.36	11.30	-5.94
				9/29/2008	5.36	11.29	-5.93
				1/13/2009	5.36	8.72	-3.36
OCPT4	2.7	73.0	63.0-73.0	6/9/2008	6.38	12.25	-5.87
				6/17/2008	6.38	12.46	-6.08
				7/30/2008	6.38	12.93	-6.55
				9/29/2008	6.38	12.97	-6.59
				1/13/2009	6.38	13.16	-6.78
OCPT5	1.5	80.0	59-64,69-74	1/13/2009	5.32	12.72	-7.40
MW-1	4.9	20.0	Not Available	8/4/2006	6.75	4.12	2.63
				10/5/2006	6.75	4.38	2.37
				6/6/2007	6.75	4.17	2.58
				9/6/2007	6.75	4.21	2.54
				11/7/2007	6.75	NM	NM
				12/3/2007	6.75	NM	NM
				6/17/2008	6.75	5.39	1.36
MW-2	4.5	15.0	Not Available	8/4/2006	5.88	4.79	1.09
				10/5/2006	5.88	3.85	2.03
				6/6/2007	5.88	3.58	2.30
				9/6/2007	5.88	3.64	2.24
				11/7/2007	5.88	NM	NM
				12/3/2007	5.88	NM	NM
				6/17/2008	5.88	5.23	0.65
MW-3	4.5	16.0	Not Available	8/4/2006	7.23	5.74	1.49
				10/5/2006	7.23	5.58	1.65
				6/6/2007	7.23	5.34	1.89
				9/6/2007	7.23	5.41	1.82
				11/7/2007	7.23	NM	NM
				12/3/2007	7.23	NM	NM
				6/17/2008	7.23	6.34	0.89
HMW-1	3.3	18.0	8.0-18.0	8/4/2006	5.15	2.54	2.61
				10/5/2006	5.15	2.64	2.51
				6/6/2007	5.15	2.89	2.26
				9/6/2007	5.15	2.61	2.54
				11/7/2007	5.15	NM	NM
				12/3/2007	5.15	NM	NM

TABLE 7 - WATER LEVEL MEASUREMENTS

Well ID	Ground Surface Elevation (ft AMSL[2])	Total Boring Depth (ft BGS[3])	Screened Interval (ft BGS[3])	Date	TOC[1] Elevation (ft AMSL[2])	Depth to Water (ft BTOC[4])	Water Elevation (ft AMSL[2])
HMW-2	2.6	18.0	8.0-18.0	8/4/2006	4.69	3.59	1.10
				10/5/2006	4.69	3.71	0.98
				6/6/2007	4.69	3.93	0.76
				9/6/2007	4.69	3.63	1.06
				11/7/2007	4.69	NM	NM
				12/3/2007	4.69	NM	NM
HMW-3	3.2	18.0	8.0-18.0	8/4/2006	5.20	3.48	1.72
				10/5/2006	5.20	3.49	1.71
				6/6/2007	5.20	3.78	1.42
				9/6/2007	5.20	3.54	1.66
				11/7/2007	5.20	NM	NM
				12/3/2007	5.20	NM	NM
BM-1	Not applicable - Staff Gauge	Not applicable Staff Gauge	Not applicable - Staff Gauge	10/5/2006	3.53	1.94	1.59
				9/6/2007	3.53	1.55	1.98
				11/7/2007	3.53	1.61	1.92
				12/3/2007	3.53	1.49	2.04
				6/17/2008	3.53	0.73[6]	2.80[6]
				7/30/2008	3.53	0.51[6]	3.02[6]
BM-2	Not applicable - Staff Gauge	Not applicable Staff Gauge	Not applicable - Staff Gauge	10/5/2006	3.30	1.76	1.54
				9/6/2007	3.30	1.35	1.95
				11/7/2007	3.30	1.42	1.88
				12/3/2007	3.30	1.29	2.01
				6/17/2008	3.30	1.42	1.88
				7/30/2008	3.30	1.45	1.85
BM-3	Not applicable - Staff Gauge	Not applicable Staff Gauge	Not applicable - Staff Gauge	10/5/2006	5.10	3.41	1.69
				9/6/2007	5.10	3.60	1.50
				11/7/2007	5.10	NM	NM
				12/3/2007	5.10	4.60	0.50
				6/17/2008	5.10	3.61	1.49

Notes:

[1] TOC = Top of PVC Well Casing.

[2] AMSL = Above Mean Sea Level (NGVD 29).

[3]BGS = Below Ground Surface

[4] BTOC = Below TOC.

[5]NM =- not measured.

[6]Settlement/damage to BM-1 staff gauge occurred after 12/07.

TABLE 8 - WATER WELL RECORDS SUMMARY

Map ID[1]	State Water Well ID	Reported Type of Well	Reported Total Depth (feet)	Reported Completion Date	Well Owner of Record	Field Verification/Current Status
1	81-06-3F	Domestic	197	8/4/1980	A.B. Williamson	Not Present - Incorrectly Located in Well Records.
2	81-06-303	Commercial	199	1/1/1966	B.G. Sandelin	Present - Does Not Appear to Have Been in Use for Some Time.
3	81-06-3H	Domestic	250	11/29/1982	Surfside Water Works	Not Present - Incorrectly Located in Well Records.
4	81-06-3E	Public Supply	435	3/3/1982	Surfside Water Works	Not Present - Incorrectly Located in Well Records.
5	81-06-3F	Domestic	204	9/24/1980	B.J. Roberts	No Well Currently Present; Well Reported to be Formerly Located on this Property Not Field Verified.
6	81-06-206 / 81-06-207	Public Supply	243	1/1/1962	Freeport Marina	Present - Capped and Not in Use.

Notes:
[1]Well Locations are shown on Figure 20.
[2] Search of Texas Water Well Development Board and Texas Commission on Environmental Quality records performed by Banks Information, Inc.

TABLE 9 - LABORATORY VERTICAL HYDRAULIC CONDUCTIVITY TESTING RESULTS

Sample Location	Sample Depth (ft below ground surface)	Vertical Hydraulic Conductivity (cm/sec)
NE4MW32C	53-55	6.55×10^{-9}
NE4MW32C	55-57	5.66×10^{-9}
SE1DB01	80-82	1.64×10^{-8}

TABLE 10
SLUG TEST RESULTS

Well Number	Test Type	Water-Bearing Unit Type	Water-Bearing Zone	Water-Bearing Unit Thickness (ft)	Hydraulic Conductivity (cm/sec)
ND4MW03	Slug	Confined	A	13	8×10^{-5}
NE1MW04	Slug	Confined	A	12	4×10^{-5}
SJ1MW15	Slug	Confined	A	12.5	7×10^{-5}
ND4MW24B	Slug	Confined	B	5	1×10^{-4}
NG3MW25B	Slug	Confined	B	16	5×10^{-4}
OMW27B	Slug	Confined	B	3	2×10^{-5}

TABLE 11 - VERTICAL GRADIENT MEASUREMENTS

Well ID	Date	MP[1] Elevation (ft AMSL[2])	Depth to Water (ft BMP[3])	Water Elevation (ft AMSL)	Vertical Gradient[4] - Zone A to B	Vertical Gradient[4] - Zone B to C
ND4MW03	6/6/2007	6.20	4.42	1.78		
	9/6/2007	6.20	3.84	2.36		
	11/7/2007	6.20	4.47	1.73		
	12/3/2007	6.20	3.73	2.47		
	6/17/2008	6.20	6.31	-0.11		
ND4MW24B	6/6/2007	5.70	3.81	1.89		
	9/6/2007	5.70	3.41	2.29		
	11/7/2007	5.70	3.78	1.92		
	12/3/2007	5.70	3.32	2.38		
	6/17/2008	5.70	5.48	0.22		
Vertical gradients for well cluster	6/6/2007				-0.03	--
	9/6/2007				0.02	--
	11/7/2007				-0.05	--
	12/3/2007				0.02	--
	6/17/2008				-0.08	--
NG3MW19	6/6/2007	5.08	3.58	1.50		
	9/6/2007	5.08	3.29	1.79		
	11/7/2007	5.08	3.77	1.31		
	12/3/2007	5.08	3.29	1.79		
	6/17/2008	5.08	4.38	0.70		
NG3MW25B	6/6/2007	4.91	3.17	1.74		
	9/6/2007	4.91	3.01	1.90		
	11/7/2007	4.91	3.15	1.76		
	12/3/2007	4.91	2.94	1.97		
	6/17/2008	4.91	3.69	1.22		
	7/30/2008	4.91	3.26	1.65		
NG3CPT1	6/9/2008	5.79	9.82	4.03		
	6/17/2008	5.79	9.47	-3.68		
	7/30/2008	5.79	9.41	-3.62		
Vertical gradients for well cluster	6/6/2007				-0.07	--
	9/6/2007				-0.03	--
	11/7/2007				-0.13	--
	12/3/2007				-0.05	--
	6/17/2008				-0.15	0.14
	7/30/2008				--	0.15

TABLE 11 - VERTICAL GRADIENT MEASUREMENTS

Well ID	Date	MP[1] Elevation (ft AMSL[2])	Depth to Water (ft BMP[3])	Water Elevation (ft AMSL)	Vertical Gradient[4] - Zone A to B	Vertical Gradient[4] - Zone B to C
OMW21	6/6/2007	5.73	4.17	1.56		
	9/6/2007	5.73	3.96	1.77		
	11/7/2007	5.73	5.07	0.66		
	12/3/2007	5.73	4.86	0.87		
	6/17/2008	5.73	6.12	-0.39		
OMW27B	6/6/2007	5.45	3.26	2.19		
	9/6/2007	5.45	3.04	2.41		
	11/7/2007	5.45	4.34	1.11		
	12/3/2007	5.45	4.17	1.28		
	6/17/2008	5.45	5.47	-0.02		
	7/30/2008	5.45	4.27	1.18		
OCPT4	6/9/2008	6.38	12.25	5.87		
	6/17/2008	6.38	12.46	-6.08		
	7/30/2008	6.38	12.93	-6.55		
Vertical gradient for well cluster	6/6/2007				-0.10	--
	9/6/2007				-0.10	--
	11/7/2007				-0.07	--
	12/3/2007				-0.06	--
	6/17/2008				-0.06	0.17
	7/30/2008				--	0.21
NE4MW31B	6/17/2008	6.01	5.04	0.97		
	7/30/2008	6.01	4.59	1.42		
NE4CPT2	6/17/2008	6.77	10.32	-3.55		
	7/30/2008	6.77	10.31	-3.54		
Vertical gradient for well cluster	6/17/2008				--	0.13
	7/30/2008				--	0.14

Notes:

[1] MP = Measurement Point (Top of PVC well casing).

[2] AMSL = Above Mean Sea Level (NGVD 29).

[3] BMP = Below Measurement Point.

[4]Vertical gradient calculated using vertical distance from base of screened interval in upper unit monitoring well to top of screened interval in lower unit monitoring well at well cluster location. A positive value indicates a downward gradient. A negative value indicates an upward gradient.

TABLE 12 - EXTENT EVALUATION COMPARISON VALUES - INTRACOASTAL WATERWAY SEDIMENTS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$ [3]	TCEQ Ecological Benchmark for Sediment [4]	EPA EcoTox Threshold [5]			
METALS						
Aluminum	1.5E+05	---	---	1.53E+05	3.31E+04	1.53E+05
Antimony	8.3E+01	---	---	8.32E+01	1.26E+01	8.32E+01
Arsenic	1.1E+02	8.20E+00	8.20E+00	8.20E+00	1.52E+01	1.52E+01
Barium	2.3E+04	---	---	8.00E+03	3.54E+02	8.00E+03
Beryllium	2.7E+01	---	---	2.66E+01	1.99E+00	2.66E+01
Boron	1.1E+05	---	---	1.07E+05	6.65E+01	1.07E+05
Cadmium	1.1E+03	1.20E+00	1.20E+00	1.20E+00	---	1.20E+00
Chromium	3.6E+04	8.10E+01	8.10E+01	8.10E+01	3.26E+01	8.10E+01
Chromium (VI)	1.4E+02	---	---	1.36E+02	---	1.36E+02
Cobalt	3.2E+04	---	---	3.20E+04	1.63E+01	3.20E+04
Copper	2.1E+04	3.40E+01	3.40E+01	3.40E+01	2.38E+01	3.40E+01
Iron	---	---	---	NV[8]	---	NV
Lead	5.0E+02	4.67E+01	4.67E+01	4.67E+01	2.05E+01	4.67E+01
Lithium	1.1E+04	---	---	1.07E+04	6.51E+01	1.07E+04
Manganese	1.4E+04	---	---	1.40E+04	6.01E+02	1.40E+04
Mercury	3.4E+01	1.50E-01	1.50E-01	1.50E-01	5.76E-02	1.50E-01
Molybdenum	1.8E+03	---	---	1.84E+03	4.46E-01	1.84E+03
Nickel	1.4E+03	2.09E+01	2.09E+01	2.09E+01	3.95E+01	3.95E+01
Selenium	2.7E+03	---	---	2.66E+03	---	2.66E+03
Silver	3.5E+02	1.00E+00	1.00E+00	1.00E+00	---	1.00E+00
Strontium	1.5E+05	---	---	1.52E+05	1.26E+02	1.52E+05
Thallium	4.3E+01	---	---	4.3E+01	---	4.30E+01
Tin	9.2E+04	---	---	9.19E+04	---	9.19E+04
Titanium	1.0E+06	---	---	1.00E+06	6.36E+01	1.00E+06
Vanadium	3.3E+02	---	---	3.29E+02	4.79E+01	3.29E+02
Zinc	7.6E+04	1.50E+02	1.50E+02	1.50E+02	7.75E+01	1.50E+02
PESTICIDES						
4,4'-DDD	1.2E+02	1.22E-03	1.22E-03	1.22E-03	---	1.22E-03
4,4'-DDE	8.7E+01	2.07E-03	2.07E-03	2.07E-03	---	2.07E-03
4,4'-DDT	8.7E+01	1.19E-03	1.19E-03	1.19E-03	---	1.19E-03
Aldrin	8.4E-01	---	---	8.36E-01	---	8.36E-01
alpha-BHC	4.1E+00	---	---	4.05E+00	---	4.05E+00

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TABLE 12 - EXTENT EVALUATION COMPARISON VALUES - INTRACOASTAL WATERWAY SEDIMENTS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$[3]	TCEQ Ecological Benchmark for Sediment[4]	EPA EcoTox Threshold[5]			
alpha-Chlordane	4.1E+01	0.00226[7]	---	2.26E-03	---	2.26E-03
beta-BHC	1.4E+01	---	---	1.42E+01	---	1.42E+01
delta-BHC	1.4E+01	---	---	1.42E+01	---	1.42E+01
Dieldrin	8.9E-01	7.15E-04	7.15E-04	7.15E-04	---	7.15E-04
Endosulfan I	3.1E+02	---	2.90E-03	2.90E-03	---	2.90E-03
Endosulfan II	9.2E+02	---	1.40E-02	1.40E-02	---	1.40E-02
Endosulfan sulfate	9.2E+02	---	---	9.19E+02	---	9.19E+02
Endrin	4.6E+01	---	3.50E-03	3.50E-03	---	3.50E-03
Endrin aldehyde	4.6E+01	---	---	4.59E+01	---	4.59E+01
Endrin ketone	4.6E+01	---	---	4.59E+01	---	4.59E+01
gamma-BHC (Lindane)	2.0E+01	3.20E-04	3.20E-04	3.20E-04	---	3.20E-04
gamma-Chlordane	4.1E+01	0.00226[7]	---	2.26E-03	---	2.26E-03
Heptachlor	3.2E+00	---	---	3.16E+00	---	3.16E+00
Heptachlor epoxide	1.6E+00	---	---	1.56E+00	---	1.56E+00
Methoxychlor	7.7E+02	---	1.90E-02	1.90E-02	---	1.90E-02
Toxaphene	1.3E+01	---	2.80E-02	2.80E-02	---	2.80E-02
PCBs	2.3E+00	2.27E-02		2.27E-02	---	2.27E-02
Aroclor-1016	---	---	---	NV	---	NV
Aroclor-1221	---	---	---	NV	---	NV
Aroclor-1232	---	---	---	NV	---	NV
Aroclor-1242	---	---	---	NV	---	NV
Aroclor-1248	---	---	---	NV	---	NV
Aroclor-1254	---	---	---	NV	---	NV
Aroclor-1260	---	---	---	NV	---	NV
VOCs						
1,1,1,2-Tetrachloroethane	2.1E+03	---	---	2.10E+03	---	2.10E+03
1,1,1-Trichloroethane	1.5E+05	2.63E+00	1.70E-01	1.70E-01	---	1.70E-01
1,1,2,2-Tetrachloroethane	2.7E+02	6.10E-01	9.40E-01	6.10E-01	---	6.10E-01
1,1,2-Trichloroethane	9.6E+02	3.00E-01	---	3.00E-01	---	3.00E-01
1,1-Dichloroethane	7.3E+04	---	---	7.35E+04	---	7.35E+04
1,1-Dichloroethene	3.7E+04	1.54E+01	---	1.54E+01	---	1.54E+01
1,1-Dichloropropene	5.4E+02	---	---	5.45E+02	---	5.45E+02
1,2,3-Trichloropropane	7.8E+00	---	---	7.79E+00	---	7.79E+00
1,2,4-Trichlorobenzene	1.5E+03	3.90E-01	9.20E+00	3.90E-01	---	3.90E-01
1,2,4-Trimethylbenzene	3.7E+04	2.16E+00	---	2.16E+00	---	2.16E+00
1,2-Dibromo-3-chloropropane	1.0E+01	---	---	1.01E+01	---	1.01E+01
1,2-Dibromoethane	2.7E+01	---	---	2.72E+01	---	2.72E+01

TABLE 12 - EXTENT EVALUATION COMPARISON VALUES - INTRACOASTAL WATERWAY SEDIMENTS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$[3]	TCEQ Ecological Benchmark for Sediment[4]	EPA EcoTox Threshold[5]			
1,2-Dichlorobenzene	6.6E+04	7.40E-01	3.40E-01	3.40E-01	---	3.40E-01
1,2-Dichloroethane	6.0E+02	4.30E+00	---	4.30E+00	---	4.30E+00
1,2-Dichloropropane	8.0E+02	2.82E+00	---	2.82E+00	---	2.82E+00
1,3,5-Trimethylbenzene	3.7E+04	---	---	3.67E+04	---	3.67E+04
1,3-Dichlorobenzene	2.2E+04	3.20E-01	1.70E+00	3.20E-01	---	3.20E-01
1,3-Dichloropropane	5.4E+02	4.00E-02	---	4.00E-02	---	4.00E-02
1,4-Dichlorobenzene	2.3E+03	7.00E-01	3.50E-01	3.50E-01	---	3.50E-01
2,2-Dichloropropane	8.0E+02	---	---	8.01E+02	---	8.01E+02
2-Butanone	4.4E+05	---	---	4.41E+05	---	4.41E+05
2-Chloroethylvinyl ether	5.0E+01	---	---	4.95E+01	---	4.95E+01
2-Chlorotoluene	3.1E+03	---	---	3.06E+03	---	3.06E+03
2-Hexanone	4.4E+04	---	---	4.41E+04	---	4.41E+04
4-Chlorotoluene	1.5E+04	---	---	1.47E+04	---	1.47E+04
4-Isopropyltoluene	7.3E+04	---	---	7.35E+04	---	7.35E+04
4-Methyl-2-pentanone	5.9E+04	4.53E+01	---	4.53E+01	---	4.53E+01
Acetone	6.6E+05	1.67E+02	---	1.67E+02	---	1.67E+02
Acrolein	3.7E+02	---	---	3.67E+02	---	3.67E+02
Acrylonitrile	1.0E+02	1.70E-01	---	1.70E-01	---	1.70E-01
Benzene	9.9E+02	1.40E-01	5.70E-02	5.70E-02	---	5.70E-02
Bromobenzene	1.5E+04	---	---	1.47E+04	---	1.47E+04
Bromodichloromethane	8.8E+02	---	---	8.79E+02	---	8.79E+02
Bromoform	6.9E+03	1.78E+00	6.50E-01	6.50E-01	---	6.50E-01
Bromomethane	1.0E+03	---	---	1.03E+03	---	1.03E+03
Butanol	7.3E+04	---	---	7.35E+04	---	7.35E+04
Carbon disulfide	7.3E+04	---	---	7.35E+04	---	7.35E+04
Carbon tetrachloride	4.2E+02	3.67E+00	1.20E+00	1.20E+00	---	1.20E+00
Chlorobenzene	1.5E+04	2.90E-01	8.20E-01	2.90E-01	---	2.90E-01
Chloroethane	2.9E+05	---	---	2.94E+05	---	2.94E+05
Chloroform	7.3E+03	4.30E+00	---	4.30E+00	---	4.30E+00
Chloromethane	4.2E+03	8.74E+00	---	8.74E+00	---	8.74E+00
cis-1,2-Dichloroethene	7.3E+03	---	---	7.35E+03	---	7.35E+03
cis-1,3-Dichloropropene	7.3E+01	---	---	7.35E+01	---	7.35E+01
Cyclohexane	1.0E+06	---	---	1.0E+06	---	1.0E+06
Dibromochloromethane	6.5E+02	---	---	6.49E+02	---	6.49E+02
Dibromomethane	7.3E+03	---	---	7.27E+03	---	7.27E+03
Dichlorodifluoromethane	1.5E+05	---	---	1.47E+05	---	1.47E+05
Ethylbenzene	7.3E+04	6.50E-01	3.60E+00	6.50E-01	---	6.50E-01

TABLE 12 - EXTENT EVALUATION COMPARISON VALUES - INTRACOASTAL WATERWAY SEDIMENTS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$ [3]	TCEQ Ecological Benchmark for Sediment [4]	EPA EcoTox Threshold [5]			
Hexachlorobutadiene	3.1E+01	2.00E-02	---	2.00E-02	---	2.00E-02
Isopropylbenzene (Cumene)	7.3E+04	---	---	7.35E+04	---	7.35E+04
Methyl acetate	7.3E+05	---	---	7.35E+05	---	7.35E+05
Methyl iodide	1.0E+03	---	---	1.03E+03	---	1.03E+03
Methylcyclohexane	1.0E+06	---	---	1.00E+06	---	1.00E+06
Methylene chloride	7.3E+03	3.82E+00	---	3.82E+00	---	3.82E+00
Naphthalene	2.5E+03	1.60E-01	1.60E-01	1.60E-01	---	1.60E-01
n-Butylbenzene	6.1E+03	---	---	6.12E+03	---	6.12E+03
n-Propylbenzene	2.9E+04	---	---	2.94E+04	---	2.94E+04
o-Xylene	1.0E+06	---	---	1.00E+06	---	1.00E+06
sec-Butylbenzene	2.9E+04	---	---	2.94E+04	---	2.94E+04
Styrene	1.5E+05	3.72E+00	---	3.72E+00	---	3.72E+00
tert-Butyl methyl ether (MTBE)	7.3E+03	---	---	7.35E+03	---	7.35E+03
tert-Butylbenzene	2.9E+04	---	---	2.94E+04	---	2.94E+04
Tetrachloroethene	1.0E+03	3.10E+00	5.30E-01	5.30E-01	---	5.30E-01
Toluene	5.9E+04	9.40E-01	6.70E-01	6.70E-01	---	6.70E-01
trans-1,2-Dichloroethene	1.5E+04	---	---	1.47E+04	---	1.47E+04
trans-1,3-Dichloropropene	5.4E+02	---	---	5.45E+02	---	5.45E+02
Trichloroethene	4.4E+03	1.47E+00	1.60E+00	1.47E+00	---	1.47E+00
Trichlorofluoromethane	2.2E+05	---	---	2.20E+05	---	2.20E+05
Trichlorotrifluoroethane	1.0E+06	---	---	1.00E+06	---	1.00E+06
Vinyl acetate	7.3E+05	---	---	7.35E+05	---	7.35E+05
Vinyl chloride	3.6E+01	---	---	3.63E+01	---	3.63E+01
Xylene (total)	1.5E+05	2.54E+00	---	2.54E+00	---	2.54E+00
SVOCs						
1,2Diphenylhydrazine/Azobenzen	1.3E+02	---	---	1.3E+02	---	1.30E+02
2,4,5-Trichlorophenol	1.5E+04	---	---	1.53E+04	---	1.53E+04
2,4,6-Trichlorophenol	1.3E+03	---	---	1.29E+03	---	1.29E+03
2,4-Dichlorophenol	4.6E+02	---	---	4.59E+02	---	4.59E+02
2,4-Dimethylphenol	3.1E+03	---	---	3.06E+03	---	3.06E+03
2,4-Dinitrophenol	3.1E+02	---	---	3.06E+02	---	3.06E+02
2,4-Dinitrotoluene	2.1E+01	---	---	2.09E+01	---	2.09E+01
2,6-Dinitrotoluene	2.1E+01	---	---	2.09E+01	---	2.09E+01
2-Chloronaphthalene	9.9E+03	---	---	9.90E+03	---	9.90E+03
2-Chlorophenol	3.7E+03	---	---	3.67E+03	---	3.67E+03
2-Methylnaphthalene	4.9E+02	7.00E-02	7.00E-02	7.00E-02	---	7.00E-02
2-Nitroaniline	4.6E+01	---	---	4.59E+01	---	4.59E+01

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TABLE 12 - EXTENT EVALUATION COMPARISON VALUES - INTRACOASTAL WATERWAY SEDIMENTS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$[3]	TCEQ Ecological Benchmark for Sediment[4]	EPA EcoTox Threshold[5]			
2-Nitrophenol	3.1E+02	---	---	3.06E+02	---	3.06E+02
3,3'-Dichlorobenzidine	3.2E+01	---	---	3.16E+01	---	3.16E+01
3-Nitroaniline	4.6E+01	---	---	4.59E+01	---	4.59E+01
4,6-Dinitro-2-methylphenol	3.1E+02	---	---	3.06E+02	---	3.06E+02
4-Bromophenyl phenyl ether	9.5E-01	---	1.30E+00	9.47E-01	---	9.47E-01
4-Chloro-3-methylphenol	7.7E+02	---	---	7.65E+02	---	7.65E+02
4-Chloroaniline	6.1E+02	---	---	6.12E+02	---	6.12E+02
4-Chlorophenyl phenyl ether	9.5E-01	---	---	9.47E-01	---	9.47E-01
4-Nitroaniline	3.7E+02	---	---	3.74E+02	---	3.74E+02
4-Nitrophenol	3.1E+02	---	---	3.06E+02	---	3.06E+02
Acenaphthene	7.4E+03	1.60E-02	1.60E-02	1.60E-02	---	1.60E-02
Acenaphthylene	7.4E+03	4.40E-02	4.40E-02	4.40E-02	---	4.40E-02
Acetophenone	1.5E+04	---	---	1.53E+04	---	1.53E+04
Aniline	1.1E+03	---	---	1.07E+03	---	1.07E+03
Anthracene	3.7E+04	8.53E-02	8.53E-02	8.53E-02	---	8.53E-02
Atrazine (Aatrex)	6.4E+01	---	---	6.40E+01	---	6.40E+01
Benzaldehyde	7.3E+04	---	---	7.35E+04	---	7.35E+04
Benzidine	6.2E-02	---	---	6.18E-02	---	6.18E-02
Benzo(a)anthracene	1.6E+01	2.61E-01	2.61E-01	2.61E-01	---	2.61E-01
Benzo(a)pyrene	1.6E+00	4.30E-01	4.30E-01	4.30E-01	---	4.30E-01
Benzo(b)fluoranthene	1.6E+01	---	---	1.59E+01	---	1.59E+01
Benzo(g,h,i)perylene	3.7E+03	---	---	3.71E+03	---	3.71E+03
Benzo(k)fluoranthene	1.6E+02	---	---	1.59E+02	---	1.59E+02
Benzoic acid	6.1E+05	---	---	6.12E+05	---	6.12E+05
Benzyl alcohol	4.6E+04	---	---	4.59E+04	---	4.59E+04
Biphenyl	7.7E+03	---	1.10E+00	1.10E+00	---	1.10E+00
Bis(2-Chloroethoxy)methane	1.3E+01	---	---	1.29E+01	---	1.29E+01
Bis(2-Chloroethyl)ether	5.0E+01	---	---	4.95E+01	---	4.95E+01
Bis(2-Chloroisopropyl)ether	2.0E+02	---	---	2.03E+02	---	2.03E+02
Bis(2-Ethylhexyl)phthalate	2.4E+02	1.82E-01	1.82E-01	1.82E-01	---	1.82E-01
Butyl benzyl phthalate	3.1E+04	---	1.10E+01	1.10E+01	---	1.10E+01
Caprolactam	7.7E+04	---	---	7.65E+04	---	7.65E+04
Carbazole	7.1E+02	---	---	7.10E+02	---	7.10E+02
Chrysene	1.6E+03	3.84E-01	3.84E-01	3.84E-01	---	3.84E-01
Dibenz(a,h)anthracene	1.6E+00	6.34E-02	6.34E-02	6.34E-02	---	6.34E-02
Dibenzofuran	6.1E+02	---	2.00E+00	2.00E+00	---	2.00E+00
Diethyl phthalate	1.2E+05	---	6.30E-01	6.30E-01	---	6.30E-01

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TABLE 12 - EXTENT EVALUATION COMPARISON VALUES - INTRACOASTAL WATERWAY SEDIMENTS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$ [3]	TCEQ Ecological Benchmark for Sediment [4]	EPA EcoTox Threshold [5]			
Dimethyl phthalate	1.2E+05	---	---	1.22E+05	---	1.22E+05
Di-n-butyl phthalate	1.5E+04	---	1.10E+01	1.10E+01	---	1.10E+01
Di-n-octyl phthalate	3.1E+03	---	---	3.06E+03	---	3.06E+03
Fluoranthene	4.9E+03	6.00E-01	6.00E-01	6.00E-01	---	6.00E-01
Fluorene	4.9E+03	1.90E-02	1.90E-02	1.90E-02	---	1.90E-02
Hexachlorobenzene	8.9E+00	---	---	8.88E+00	---	8.88E+00
Hexachlorocyclopentadiene	9.2E+02	---	---	9.19E+02	---	9.19E+02
Hexachloroethane	1.5E+02	---	1.00E+00	1.00E+00	---	1.00E+00
Indeno(1,2,3-cd)pyrene	1.6E+01	---	---	1.59E+01	---	1.59E+01
Isophorone	1.5E+04	---	---	1.50E+04	---	1.50E+04
Nitrobenzene	7.7E+01	---	---	7.65E+01	---	7.65E+01
n-Nitrosodimethylamine	1.1E+00	---	---	1.07E+00	---	1.07E+00
n-Nitrosodi-n-propylamine	6.3E-01	---	---	6.31E-01	---	6.31E-01
n-Nitrosodiphenylamine	9.0E+02	---	---	9.01E+02	---	9.01E+02
o-Cresol	7.7E+03	---	---	7.65E+03	---	7.65E+03
Pentachlorophenol	5.6E+01	---	---	5.61E+01	---	5.61E+01
Phenanthrene	3.7E+03	2.40E-01	2.40E-01	2.40E-01	---	2.40E-01
Phenol	4.6E+04	---	---	4.59E+04	---	4.59E+04
Pyrene	3.7E+03	6.65E-01	6.65E-01	6.65E-01	---	6.65E-01
Pyridine	7.3E+02	---	---	7.35E+02	---	7.35E+02
Chloride	---	---	---	NV	NV	NV
Sulfate	---	---	---	NV	NV	NV
Total Moisture	---	---	---	NV	NV	NV
Total Organic Carbon	---	---	---	NV	NV	NV

Notes

1. All values in mg/kg.
2. Values from Table 21 of RI/FS Work Plan (updated to reflect changes since 2005 where applicable)
3. $^{Tot}Sed_{Comb}$ PCL = TCEQ Protective Concentration Level for total sediment combined pathway (includes inhalation; ingestion; dermal pathways).
4. From Table 3-3 of TCEQ "Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas".
5. From Table 2 of EPA "Ecotox Thresholds" ECO Update January 1996.
6. 95% UTL calculated from site-specific background samples.
7. Value listed is for total Chlordane.
8. NV = No Preliminary Screening Value.

TABLE 13 - DETECTED INTRACOASTAL WATERWAY RI SEDIMENT SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Date	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
IWSE01	6/26/2006	4,4'-DDT	0.00332J[2]	0.00119
IWSE03	6/26/2006	Acenaphthene	0.0631J	0.016
		Benzo(a)anthracene	0.395	0.261
		Benzo(a)pyrene	0.445	0.43
		Chrysene	0.475J	0.384
		Dibenz(a,h)anthracene	0.151	0.0634
		Fluoranthene	0.804J-	0.6
		Fluorene	0.046J	0.019
		Phenanthrene	0.508	0.24
		Pyrene	0.862	0.665
IWSE04	6/26/2006	Dibenz(a,h)anthracene	0.0694J	0.0634
IWSE05	6/26/2006	Fluorene	0.0241J	0.019
IWSE07	6/26/2006	Acenaphthene	0.0239J	0.016
		Dibenz(a,h)anthracene	0.235	0.0634
		Fluorene	0.0277J	0.019

Notes:

(1) Extent Evaluation Comparison Values from Table 12.

(2) Data qualifiers: J = estimated value. J- = estimated value, biased low.

TABLE 14 - SURFACE WATER EXTENT EVALUATION COMPARISON VALUES [1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 20 of RI/FS Work Plan[2]		Extent Evaluation Comparison Value
	Human Health Surface Water Risk Based Exposure Limits (^{SW}RBELs) Saltwater Fish Only[3]	TCEQ Ecological Benchmark for Water[4]	
METALS[5]			
Aluminum	---	---	NV
Antimony	6.40E-01	---	6.40E-01
Arsenic	1.40E-03	---	1.40E-03
Dissolved Arsenic		7.80E-02	7.80E-02
Barium	---	2.50E+01	2.50E+01
Beryllium	---	---	NV
Boron	---	---	NV
Dissolved Cadmium	---	1.00E-02	1.00E-02
Dissolved Chromium	2.22E+00	1.03E-01	1.03E-01
Dissolved Chromium (VI)	---	4.96E-02	4.96E-02
Cobalt	---	---	NV
Dissolved Copper	---	3.60E-03	3.60E-03
Ferric Iron	---	---	NV
Iron	---	---	NV
Dissolved Lead	1.69E-02	5.30E-03	5.30E-03
Lithium	---	---	NV
Manganese	1.00E-01	---	1.00E-01
Mercury	2.50E-05	1.10E-03	2.50E-05
Molybdenum	---	---	NV
Nickel	4.60E+00	---	4.60E+00
Dissolved Nickel		1.31E-02	1.31E-02
Selenium	4.20E+00	1.36E-01	1.36E-01
Dissolved Silver	---	1.90E-04	1.90E-04
Strontium	---	---	NV
Thallium	4.70E-04	2.13E-02	4.70E-04
Tin	---	---	NV
Titanium	---	---	NV
Vanadium	---	---	NV
Zinc	2.60E+01	---	2.60E+01
Dissolved Zinc	---	8.42E-02	8.42E-02

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TABLE 14 - SURFACE WATER EXTENT EVALUATION COMPARISON VALUES (1)

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 20 of RI/FS Work Plan(2)		Extent Evaluation Comparison Value
	Human Health Surface Water Risk Based Exposure Limits (^{SW}RBELs) Saltwater Fish Only(3)	TCEQ Ecological Benchmark for Water(4)	
PESTICIDES			NV
4,4'-DDD	7.00E-06	2.50E-05	7.00E-06
4,4'-DDE	5.00E-06	1.40E-04	5.00E-06
4,4'-DDT	5.00E-06	1.00E-06	1.00E-06
Aldrin	2.80E-06	1.30E-04	2.80E-06
alpha-BHC	---	2.50E-02	2.50E-02
alpha-Chlordane	2.13E-05	---	2.13E-05
beta-BHC	---	---	NV
delta-BHC	---	---	NV
Dieldrin	---	2.00E-06	2.00E-06
Endosulfan I	8.90E-02	9.00E-06	9.00E-06
Endosulfan II	8.90E-02	9.00E-06	9.00E-06
Endosulfan sulfate	8.90E-02	9.00E-06	9.00E-06
Endrin	8.93E-04	2.00E-06	2.00E-06
Endrin aldehyde	3.00E-04	---	3.00E-04
Endrin ketone	---	---	NV
gamma-BHC (Lindane)	---	1.60E-05	1.60E-05
gamma-Chlordane	---	---	NV
Heptachlor	1.77E-06	4.00E-06	1.77E-06
Heptachlor epoxide	7.23E-04	3.60E-06	3.60E-06
Methoxychlor	1.48E-03	3.00E-05	3.00E-05
Toxaphene	9.00E-06	2.00E-07	2.00E-07
PCBs	8.85E-07	3.00E-05	8.85E-07
Aroclor-1016	---	---	NV
Aroclor-1221	---	---	NV
Aroclor-1232	---	---	NV
Aroclor-1242	---	---	NV
Aroclor-1248	---	---	NV
Aroclor-1254	---	---	NV
Aroclor-1260	---	---	NV

TABLE 14 - SURFACE WATER EXTENT EVALUATION COMPARISON VALUES [1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 20 of RI/FS Work Plan[2]		Extent Evaluation Comparison Value
	Human Health Surface Water Risk Based Exposure Limits (^{SW}RBELs) Saltwater Fish Only[3]	TCEQ Ecological Benchmark for Water[4]	
VOCs			
1,1,1,2-Tetrachloroethane	---	---	NV
1,1,1-Trichloroethane	---	1.56E+00	1.56E+00
1,1,2,2-Tetrachloroethane	4.00E-02	4.51E-01	4.00E-02
1,1,2-Trichloroethane	---	2.75E-01	2.75E-01
1,1-Dichloroethane	---	---	NV
1,1-Dichloroethene	---	1.25E+01	1.25E+01
1,1-Dichloropropene	---	---	NV
1,2,3-Trichloropropane	---	---	NV
1,2,4-Trichlorobenzene	7.00E-02	2.20E-02	2.20E-02
1,2,4-Trimethylbenzene	---	2.17E-01	2.17E-01
1,2-Dibromo-3-chloropropane	---	---	NV
1,2-Dibromoethane	2.23E-04	---	2.23E-04
1,2-Dichlorobenzene	1.30E+00	9.90E-02	9.90E-02
1,2-Dichloroethane	4.93E-02	5.65E+00	4.93E-02
1,2-Dichloroethene(Total)	---	6.80E-01	6.80E-01
1,2-Dichloropropane	1.50E-01	2.40E+00	1.50E-01
1,3,5-Trimethylbenzene	---	---	NV
1,3-Dichlorobenzene	9.60E-01	1.42E-01	1.42E-01
1,3-Dichloropropane	1.50E-01	---	1.50E-01
1,4-Dichlorobenzene	1.90E-01	9.90E-02	9.90E-02
2,2-Dichloropropane	---	---	NV
2-Butanone	---	---	NV
2-Chloroethylvinyl ether	---	---	NV
2-Chlorotoluene	---	---	NV
2-Hexanone	---	---	NV
4-Chlorotoluene	---	---	NV
4-Isopropyltoluene	---	---	NV
4-Methyl-2-pentanone	---	6.15E+01	6.15E+01

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TABLE 14 - SURFACE WATER EXTENT EVALUATION COMPARISON VALUES [1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 20 of RI/FS Work Plan[2]		Extent Evaluation Comparison Value
	Human Health Surface Water Risk Based Exposure Limits (^{SW}RBELs) Saltwater Fish Only[3]	TCEQ Ecological Benchmark for Water[4]	
Acetone	---	2.82E+02	2.82E+02
Acrolein	2.90E-01	5.00E-03	5.00E-03
Acrylonitrile	7.30E-03	2.91E-01	7.30E-03
Benzene	7.08E-02	1.09E-01	7.08E-02
Bromobenzene	---	---	NV
Bromodichloromethane	---	---	NV
Bromoform	1.40E+00	1.22E+00	1.22E+00
Bromomethane	---	6.00E-01	6.00E-01
Butanol	---	---	NV
Carbon disulfide	---	---	NV
Carbon tetrachloride	5.60E-03	1.50E+00	5.60E-03
Chlorobenzene	9.20E-01	1.05E-01	1.05E-01
Chloroethane	---	---	NV
Chloroform	8.61E-01	4.10E+00	8.61E-01
Chloromethane	---	1.35E+01	1.35E+01
cis-1,2-Dichloroethene	---	6.80E-01	6.80E-01
cis-1,3-Dichloropropene	1.07E-01	---	1.07E-01
Cyclohexane	---	---	NV
Dibromochloromethane	4.77E-02	---	4.77E-02
Dibromomethane	---	---	NV
Dichlorodifluoromethane	---	---	NV
Ethylbenzene	2.10E+00	2.49E-01	2.49E-01
Hexachlorobutadiene	2.40E-03	3.20E-04	3.20E-04
Isopropylbenzene (Cumene)	---	---	NV
m,p-Xylene	---	---	NV
Methyl acetate	---	---	NV
Methyl iodide	---	---	NV
Methylcyclohexane	---	---	NV
Methylene chloride	5.90E+00	5.42E+00	5.42E+00
Naphthalene	---	1.25E-01	1.25E-01
n-Butylbenzene	---	---	NV

TABLE 14 - SURFACE WATER EXTENT EVALUATION COMPARISON VALUES [1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 20 of RI/FS Work Plan[2]: Human Health Surface Water Risk Based Exposure Limits (^{SW}RBELs) Saltwater Fish Only[3]	Potential Preliminary Screening Values (PSVs) from Table 20 of RI/FS Work Plan[2]: TCEQ Ecological Benchmark for Water[4]	Extent Evaluation Comparison Value
n-Propylbenzene	---	---	NV
o-Xylene	---	---	NV
sec-Butylbenzene	---	---	NV
Styrene	---	4.55E-01	4.55E-01
tert-Butyl methyl ether (MTBE)	---	---	NV
tert-Butylbenzene	---	---	NV
Tetrachloroethene	---	1.45E+00	1.45E+00
Toluene	1.50E+01	4.80E-01	4.80E-01
trans-1,2-Dichloroethene	---	6.80E-01	6.80E-01
trans-1,3-Dichloropropene	1.07E-01	---	1.07E-01
trans-1,4-Dichloro-2-butene	---	---	NV
Trichloroethene	---	9.70E-01	9.70E-01
Trichlorofluoromethane	---	---	NV
Trichlorotrifluoroethane	---	---	NV
Vinyl acetate	---	---	NV
Vinyl chloride	2.77E-01	---	2.77E-01
Xylene (total)	---	8.50E-01	8.50E-01
SVOCs			
1,2Diphenylhydrazine/Azobenzen	2.00E-03	---	2.00E-03
2,4,5-Trichlorophenol	7.12E-01	1.20E-02	1.20E-02
2,4,6-Trichlorophenol	2.40E-02	6.10E-02	2.40E-02
2,4-Dichlorophenol	2.90E-01	---	2.90E-01
2,4-Dimethylphenol	8.50E-01	---	8.50E-01
2,4-Dinitrophenol	5.30E+00	6.70E-01	6.70E-01
2,4-Dinitrotoluene	3.40E-02	---	3.40E-02
2,6-Dinitrotoluene	---	---	NV
2-Chloronaphthalene	1.60E+00	---	1.60E+00
2-Chlorophenol	1.50E-01	2.65E-01	1.50E-01
2-Methylnaphthalene	---	3.00E-02	3.00E-02
2-Nitroaniline	---	---	NV
2-Nitrophenol	---	1.47E+00	1.47E+00
3,3'-Dichlorobenzidine	2.80E-04	3.70E-02	2.80E-04
3-Nitroaniline	---	---	NV
4,6-Dinitro-2-methylphenol	---	---	NV

TABLE 14 - SURFACE WATER EXTENT EVALUATION COMPARISON VALUES (1)

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 20 of RI/FS Work Plan(2)		Extent Evaluation Comparison Value
	Human Health Surface Water Risk Based Exposure Limits (^{SW}RBELs) Saltwater Fish Only(3)	TCEQ Ecological Benchmark for Water(4)	
4-Bromophenyl phenyl ether	---	---	NV
4-Chloro-3-methylphenol	---	---	NV
4-Chloroaniline	---	---	NV
4-Chlorophenyl phenyl ether	---	---	NV
4-Nitroaniline	---	---	NV
4-Nitrophenol	---	3.59E-01	3.59E-01
Acenaphthene	9.90E-01	4.04E-02	4.04E-02
Acenaphthylene	---	---	NV
Acetophenone	---	---	NV
Aniline	---	---	NV
Anthracene	4.00E+01	1.80E-04	1.80E-04
Atrazine (Aatrex)	---	---	NV
Benzaldehyde	---	---	NV
Benzidine	---	---	NV
Benzo(a)anthracene	---	---	NV
Benzo(a)pyrene	---	---	NV
Benzo(b)fluoranthene	---	---	NV
Benzo(g,h,i)perylene	---	---	NV
Benzo(k)fluoranthene	---	---	NV
Benzoic acid	---	---	NV
Benzyl alcohol	---	---	NV
Biphenyl	---	---	NV
Bis(2-Chloroethoxy)methane	---	---	NV
Bis(2-Chloroethyl)ether	---	---	NV
Bis(2-Chloroisopropyl)ether	---	---	NV
Bis(2-Ethylhexyl)phthalate	---	---	NV
Butyl benzyl phthalate	1.90E+00	1.47E-01	1.47E-01
Caprolactam	---	---	NV
Carbazole	---	---	NV
Chrysene	---	---	NV
Dibenz(a,h)anthracene	---	---	NV
Dibenzofuran	---	6.50E-02	6.50E-02
Diethyl phthalate	4.40E+01	4.42E-01	4.42E-01
Dimethyl phthalate	1.10E+03	5.80E-01	5.80E-01

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TABLE 14 - SURFACE WATER EXTENT EVALUATION COMPARISON VALUES (1)

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 20 of RI/FS Work Plan(2)		Extent Evaluation Comparison Value
	Human Health Surface Water Risk Based Exposure Limits (^{SW}RBELs) Saltwater Fish Only(3)	TCEQ Ecological Benchmark for Water(4)	
Di-n-butyl phthalate	4.50E+00	5.00E-03	5.00E-03
Di-n-octyl phthalate	---	---	NV
Fluoranthene	1.40E-01	2.96E-03	2.96E-03
Fluorene	5.30E+00	5.00E-02	5.00E-02
Hexachlorobenzene	---	---	NV
Hexachlorocyclopentadiene	1.10E+00	7.00E-05	7.00E-05
Hexachloroethane	1.85E-01	9.40E-03	9.40E-03
Indeno(1,2,3-cd)pyrene	---	---	NV
Isophorone	9.60E+00	6.50E-01	6.50E-01
m,p-Cresol	---	---	NV
Nitrobenzene	1.56E-01	6.68E-02	6.68E-02
n-Nitrosodimethylamine	3.00E-02	1.65E+02	3.00E-02
n-Nitrosodi-n-propylamine	5.10E-03	1.20E-01	5.10E-03
n-Nitrosodiphenylamine	6.00E-02	1.65E+02	6.00E-02
o-Cresol	8.74E+00	5.10E-01	5.10E-01
Pentachlorophenol	9.00E-02	9.60E-03	9.60E-03
Phenanthrene	---	4.60E-03	4.60E-03
Phenol	1.70E+03	2.75E+00	2.75E+00
Pyrene	4.00E+00	2.40E-04	2.40E-04
Pyridine	8.89E+00	---	8.89E+00
Chloride	---	---	NV
Sulfate	---	---	NV
Total Dissolved Solids(TDS)	---	---	NV
Total Suspended Solids	---	---	NV
Total Organic Carbon	---	---	NV
Hardness	---	---	NV

Notes:

1. All values in mg/L.
2. Values from Table 20 of RI/FS Work Plan (updated to reflect changes since 2005 where applicable).
3. From TCEQ Aquatic Life Surface Water RBEL Table and Human Health Surface Water RBEL Table updated October 2005, available at http://www.tceq.state.tx.us/assets/public/remediation/trpp/swrbelstable.pdf
4. From Table 3-2 of TCEQ "Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas."
5. Metals values are for total concentrations unless indicated otherwise.
6. NV = No Preliminary Screening Value.

TABLE 15 - EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA SOILS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 16 of RI/FS Work Plan[2]								Potential Background Values		
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\,3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW\text{-}Soil_{Inh\text{-}V}$[7]	EPA Ecological Soil Screening Level[8]	TCEQ Ecological Benchmark[9]	PSV	TCEQ[11]	Site-Specific[12]	Extent Evaluation Comparison Value
METALS											
Aluminum	7.6E+04	6.4E+04[13]	1E+06[13]	---	---	---	---	6.4E+04	3.0E+04	---	6.4E+04
Antimony	3.1E+01	1.5E+01	2.7E+02	---	---	2.7E-01 ***	5.0E+00 +	2.7E-01	1.0E+00	---	1.0E+00
Arsenic	3.9E-01	2.4E+01	2.5E+02	---	---	1.8E+01	1.8E+01 +	3.9E-01	5.9E+00	8.7E+00	8.7E+00
Barium	5.5E+03	7.8E+03[13]	2.2E+04	---	---	3.3E+02 *	3.3E+02	3.3E+02	3.0E+02	4.6E+02	4.6E+02
Beryllium	1.5E+02	3.8E+01	9.2E+01	---	---	2.1E+01 ***	1.0E+01 +	1.0E+01	1.5E+00	---	1.0E+01
Boron	1.6E+04	1.6E+04	---	---	---	---	5.0E-01 +	5.0E-01	3.0E+01	---	3.0E+01
Cadmium	3.9E+01	5.2E+01	7.5E+01	---	---	3.6E-01 ***	3.2E+01 +	3.6E-01	---	---	3.6E-01
Chromium	---	2.3E+04	1.2E+05	---	---	---	4.0E-01	4.0E-01	3.0E+01	2.4E+01	3.0E+01
Chromium (VI)	3.0E+01	1.2E+02	1.4E+03	---	---	8.1E+01 ***	---	3.0E+01	---	---	3.0E+01
Cobalt	9.0E+02	2.1E+01[13]	3.3E+02[13]	---	---	1.3E+01	1.3E+01 +	1.3E+01	7.0E+00	---	1.3E+01
Copper	2.9E+03	5.5E+02	5.2E+04	---	---	---	6.1E+01	6.1E+01	1.5E+01	2.4E+01	6.1E+01
Iron	5.3E+04[14]	---	---	---	---	---	---	5.3E+04[14]	1.5E+04	---	5.3E+04
Lead	4.0E+02	5.0E+02	1.5E+02	---	---	1.1E+01 **	1.2E+02 +	1.1E+01	1.5E+01	1.8E+01	1.8E+01
Lithium	1.6E+03	1.3E+02[13]	---	---	---	---	2.0E+00 +	2.0E+00	---	3.6E+01	3.6E+01
Manganese	3.2E+03	3.4E+03	5.8E+04	---	---	---	5.0E+02 +	5.0E+02	3.0E+02	6.5E+02	6.5E+02
Mercury	2.3E+01	2.1E+00	3.9E-01	2.4E+00	1.8E+00	---	1.0E-01	1.0E-01	4.0E-02	3.5E-02	1.0E-01
Molybdenum	3.9E+02	1.6E+02	2.5E+03	---	---	---	2.0E+00 +	2.0E+00	---	7.4E-01	2.0E+00
Nickel	1.6E+03	8.3E+02	7.9E+03	---	---	---	3.0E+01 +	3.0E+01	1.0E+01	---	3.0E+01
Selenium	3.9E+02	3.1E+02	1.1E+02	---	---	---	1.0E+00 +	1.0E+00	3.0E-01	---	1.0E+00
Silver	3.9E+02	9.5E+01	2.4E+01	---	---	---	2.0E+00 +	2.0E+00	---	---	2.0E+00
Strontium	4.7E+04	4.4E+04	3.1E+04	---	---	---	---	3.1E+04	1.0E+02	---	3.1E+04
Thallium	---	6.3E+00	8.7E+01	---	---	---	1.0E+00 +	1.0E+00	9.3E+00	---	9.3E+00
Tin	---	3.5E+04	1.0E+06	---	---	---	5.0E+01 +	5.0E+01	9.0E-01	---	5.0E+01
Titanium	---	1.0E+06	---	---	---	---	---	1.0E+06	2.0E+03	---	1.0E+06
Vanadium	7.8E+01	2.9E+02	1.7E+05	---	---	7.8E+00 **	2.0E+00 +	2.0E+00	5.0E+01	---	5.0E+01
Zinc	2.3E+04	9.9E+03	1.2E+05	---	---	---	1.2E+02	1.2E+02	3.0E+01	2.8E+02	2.8E+02
PESTICIDES											
4,4'-DDD	2.4E+00	1.4E+01	6.5E+02	---	---	---	---	2.4E+00	---	---	2.4E+00
4,4'-DDE	1.7E+00	1.0E+01	5.9E+02	---	---	---	---	1.7E+00	---	---	1.7E+00
4,4'-DDT	1.7E+00	5.4E+00	7.4E+02	6.2E+02	2.2E+05	---	---	1.7E+00	---	---	1.7E+00
Aldrin	2.9E-02	5.0E-02	5.1E+00	4.3E+00	5.5E+02	---	---	2.9E-02	---	---	2.9E-02
alpha-BHC	9.0E-02	2.5E-01	4.0E-01	7.2E+00	5.4E+02	---	---	9.0E-02	---	---	9.0E-02
beta-BHC	3.2E-01	9.2E-01[13]	1.4E+00[13]	3.7E+01[13]	4.2E+03[13]	---	---	3.2E-01	---	---	3.2E-01
alpha-Chlordane	---	1.3E+01[13]	3.7E+04[13]	2.1E+03[13]	1.0E+06[13]	---	---	1.3E+01[13]	---	---	1.3E+01[13]
delta-BHC	---	2.9E+00	8.7E+00	5.2E+01	8.0E+03	---	---	2.9E+00	---	---	2.9E+00
Dieldrin	3.0E-02	1.5E-01	2.4E+00	1.6E+01	7.0E+03	3.2E-05 ***	---	3.2E-05	---	---	3.2E-05
Endosulfan I	---	4.7E+01	1.5E+03	9.6E+01	3.7E+04	---	---	4.7E+01	---	---	4.7E+01
Endosulfan II	---	2.7E+02	4.6E+03	---	---	---	---	2.7E+02	---	---	2.7E+02
Endosulfan sulfate	---	3.8E+02	2.3E+05	---	---	---	---	3.8E+02	---	---	3.8E+02

TABLE 15 - EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA SOILS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 16 of RI/FS Work Plan[2]								Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\ 3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW\text{-}Soil_{Inh\text{-}V}$[7]	EPA Ecological Soil Screening Level[8]	TCEQ Ecological Benchmark[9]	PSV	TCEQ[11]	Site-Specific[12]	
Endrin	1.8E+01	8.7E+00	3.8E+01	2.4E+02	7.9E+04	---	---	8.7E+00	---	---	8.7E+00
Endrin aldehyde	---	1.9E+01	3.1E+04	---	---	---	---	1.9E+01	---	---	1.9E+01
Endrin ketone	---	1.9E+01	2.5E+03	9.7E+02	1.0E+06	---	---	1.9E+01	---	---	1.9E+01
gamma-BHC (Lindane)	4.4E-01	1.1E+00	4.6E-01	3.0E+02	2.5E+04	---	---	4.4E-01	---	---	4.4E-01
gamma-Chlordane	---	7.3E+00	2.1E+03	5.0E+02	1.6E+05	---	---	7.3E+00	---	---	7.3E+00
Heptachlor	1.1E-01	1.3E-01	9.4E+00	4.7E+00	1.9E+02	---	---	1.1E-01	---	---	1.1E-01
Heptachlor epoxide	5.3E-02	2.4E-01	2.9E+00	1.2E+01	2.2E+03	---	---	5.3E-02	---	---	5.3E-02
Methoxychlor	3.1E+02	2.7E+02	6.2E+03	1.6E+04	1.0E+06	---	---	2.7E+02	---	---	2.7E+02
Toxaphene	4.4E-01	1.2E+00	5.8E+02	4.9E+02	4.4E+05	---	---	4.4E-01	---	---	4.4E-01
PCBs	2.2E-01	1.1E+00	5.3E+02	2.8E+01	4.0E+03	---	---	2.2E-01	---	---	2.2E-01
Aroclor-1016	3.9E+00	---	---	---	---	---	---	3.9E+00	---	---	3.9E+00
Aroclor-1221	2.2E-01	---	---	---	---	---	---	2.2E-01	---	---	2.2E-01
Aroclor-1232	2.2E-01	---	---	---	---	---	---	2.2E-01	---	---	2.2E-01
Aroclor-1242	2.2E-01	---	---	---	---	---	---	2.2E-01	---	---	2.2E-01
Aroclor-1248	2.2E-01	---	---	---	---	---	---	2.2E-01	---	---	2.2E-01
Aroclor-1254	2.2E-01	---	---	---	---	---	---	2.2E-01	---	---	2.2E-01
Aroclor-1260	2.2E-01	---	---	---	---	---	---	2.2E-01	---	---	2.2E-01
VOCs											
1,1,1,2-Tetrachloroethane	3.0E+00	3.9E+01	7.1E+01	4.7E+01	2.9E+02	---	---	3.0E+00	---	---	3.0E+00
1,1,1-Trichloroethane	1.4E+03	3.2E+04[13]	8.1E+01	4.0E+04[13]	2.1E+04[13]	---	---	8.1E+01	---	---	8.1E+01
1,1,2,2-Tetrachloroethane	3.8E-01	4.0E+00	1.2E+00	4.6E+00	1.4E+01	---	---	3.8E-01	---	---	3.8E-01
1,1,2-Trichloroethane	8.4E-01	1.0E+01	1.0E+00	1.2E+01	2.1E+01	---	---	8.4E-01	---	---	8.4E-01
1,1-Dichloroethane	5.9E+02	6.5E+02	4.6E+01	3.2E+03	1.8E+03	---	---	4.6E+01	---	---	4.6E+01
1,1-Dichloroethene	2.8E+02	2.6E+03[13]	9.2E+02[13]	2.7E+03[13]	7.7E+02[13]	---	---	2.8E+02	---	---	2.8E+02
1,1-Dichloropropene	---	2.6E+01	6.7E+00	4.6E+01	1.8E+01	---	---	6.7E+00	---	---	6.7E+00
1,2,3-Trichloropropane	1.4E-03	8.7E-01	1.1E-01	1.4E+03	7.3E+03	---	---	1.4E-03	---	---	1.4E-03
1,2,4-Trichlorobenzene	6.8E+01	6.1E+02[13]	2.4E+02	7.8E+03[13]	6.9E+04[13]	---	2.0E+01	2.0E+01	---	---	2.0E+01
1,2,4-Trimethylbenzene	5.2E+01	8.0E+01[13]	2.4E+03	8.1E+01[13]	4.9E+02[13]	---	---	5.2E+01	---	---	5.2E+01
1,2-Dibromo-3-chloropropane	4.6E-01	8.0E-02[13]	8.7E-02	8.1E-02[13]	3.5E-01[13]	---	---	8.0E-02	---	---	8.0E-02
1,2-Dibromoethane	2.8E-02	4.3E-01[13]	1.0E-02	5.0E-01[13]	1.5E+00[13]	---	---	1.0E-02	---	---	1.0E-02
1,2-Dichlorobenzene	2.8E+02	3.9E+02	8.9E+02	4.1E+02	2.2E+03	---	---	2.8E+02	---	---	2.8E+02
1,2-Dichloroethane	3.5E-01	6.4E+00	6.9E-01	7.1E+00	5.9E+00	---	---	3.5E-01	---	---	3.5E-01
1,2-Dichloropropane	3.5E-01	3.1E+01	1.1E+00	3.2E+01	3.4E+01	---	7.0E+02	3.5E-01	---	---	3.5E-01
1,3,5-Trimethylbenzene	2.1E+01	5.9E+01	2.7E+03	6.0E+01	3.5E+02	---	---	2.1E+01	---	---	2.1E+01
1,3-Dichlorobenzene	9.3E+01	6.2E+01	3.4E+02	6.3E+01	1.1E+02	---	---	6.2E+01	---	---	6.2E+01
1,3-Dichloropropane	---	2.6E+01	3.2E+00	4.6E+01	1.2E+02	---	---	3.2E+00	---	---	3.2E+00
1,4-Dichlorobenzene	3.2E+00	2.5E+02	1.1E+02	1.3E+03[13]	6.5E+03[13]	---	2.0E+01	3.2E+00	---	---	3.2E+00
2,2-Dichloropropane	---	3.1E+01	6.0E+00	3.2E+01	3.3E+01	---	---	6.0E+00	---	---	6.0E+00
2-Butanone	3.2E+04	2.7E+04	1.5E+03	5.9E+04	3.5E+05	---	---	1.5E+03	---	---	1.5E+03
2-Chloroethylvinyl ether	---	2.3E+00	1.4E-01	2.4E+00	4.4E+00	---	---	1.4E-01	---	---	1.4E-01

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TABLE 15 - EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA SOILS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 16 of RI/FS Work Plan[2]								Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\ 3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW\text{-}Soil_{Inh\text{-}V}$[7]	EPA Ecological Soil Screening Level[8]	TCEQ Ecological Benchmark[9]	PSV	TCEQ[11]	Site-Specific[12]	
2-Chlorotoluene	1.6E+02	8.3E+02	4.5E+02	2.2E+03	9.2E+03	---	---	1.6E+02	---	---	1.6E+02
2-Hexanone	---	5.6E+01	1.9E+02	5.7E+01	2.6E+02	---	---	5.6E+01	---	---	5.6E+01
4-Chlorotoluene	---	2.5E+00	1.9E+03[13]	2.5E+00	1.1E+01	---	---	2.5E+00	---	---	2.5E+00
4-Isopropyltoluene	---	2.5E+03	1.2E+04	3.5E+03	2.8E+04	---	---	2.5E+03	---	---	2.5E+03
4-Methyl-2-pentanone	5.8E+03	5.4E+03	2.5E+02	3.0E+04	1.1E+05	---	---	2.5E+02	---	---	2.5E+02
Acetone	7.0E+04	5.4E+03	2.1E+03	5.8E+03	3.2E+04	---	---	2.1E+03	---	---	2.1E+03
Acrolein	1.0E-01	5.7E-01	1.2E+00	5.8E-01	8.8E+00	---	---	1.0E-01	---	---	1.0E-01
Acrylonitrile	2.1E-01	2.2E+00	1.7E-01	2.7E+00	7.4E+00	---	---	1.7E-01	---	---	1.7E-01
Benzene	6.6E-01	4.8E+01[13]	1.3E+00	8.4E+01[13]	6.0E+01[13]	---	---	6.6E-01	---	---	6.6E-01
Bromobenzene	7.3E+01	7.9E+01[13]	2.9E+02	8.3E+01[13]	2.9E+02[13]	---	---	7.3E+01	---	---	7.3E+01
Bromodichloromethane	1.0E+00	9.8E+01	3.3E+00	---	---	---	---	1.0E+00	---	---	1.0E+00
Bromoform	6.2E+01	2.8E+02	3.2E+01	4.3E+02	1.8E+03	---	---	3.2E+01	---	---	3.2E+01
Bromomethane	3.9E+00	2.9E+01	6.5E+00	3.9E+01	1.1E+01	---	---	3.9E+00	---	---	3.9E+00
Butanol	6.1E+03	1.8E+03	2.6E+02	2.3E+03	2.7E+04	---	---	2.6E+02	---	---	2.6E+02
Carbon disulfide	7.2E+02	3.3E+03	6.8E+02	5.5E+03	1.7E+03	---	---	6.8E+02	---	---	6.8E+02
Carbon tetrachloride	2.4E-01	9.7E+00	3.1E+00	1.2E+01	6.3E+00	---	---	2.4E-01	---	---	2.4E-01
Chlorobenzene	3.2E+02	3.2E+02[13]	5.5E+01	4.0E+02[13]	8.2E+02[13]	---	4.0E+01	4.0E+01	---	---	4.0E+01
Chloroethane	3.0E+00	2.3E+04	1.5E+03	7.9E+04	2.4E+04	---	---	3.0E+00	---	---	3.0E+00
Chloroform	2.5E-01	8.0E+00	5.1E+01	8.0E+00	5.4E+00	---	---	2.5E-01	---	---	2.5E-01
Chloromethane	1.3E+00	8.4E+01	2.0E+01	1.0E+02	1.4E+01	---	---	1.3E+00	---	---	1.3E+00
cis-1,2-Dichloroethene	4.3E+01	7.2E+02	1.2E+01	6.3E+03	3.7E+03	---	---	1.2E+01	---	---	1.2E+01
cis-1,3-Dichloropropene	---	7.1E+00	3.3E-01	5.3E+01	5.9E+01	---	---	3.3E-01	---	---	3.3E-01
Cyclohexane	6.8E+03	4.2E+04	2.9E+05	4.7E+04	1.8E+04	---	---	6.8E+03	---	---	6.8E+03
Dibromochloromethane	1.0E+00	7.2E+01	2.5E+00	---	---	---	---	1.0E+00	---	---	1.0E+00
Dibromomethane	1.4E+02	1.4E+02	5.6E+01	1.4E+02	4.7E+02	---	---	5.6E+01	---	---	5.6E+01
Dichlorodifluoromethane	9.4E+01	1.2E+04	1.2E+04	3.9E+04	9.4E+03	---	---	9.4E+01	---	---	9.4E+01
Ethylbenzene	2.3E+02	4.0E+03	3.8E+02	7.9E+03	1.1E+04	---	---	2.3E+02	---	---	2.3E+02
Hexachlorobutadiene	6.2E+00	1.2E+01	1.6E+02[13]	1.5E+01	1.6E+02	---	---	6.2E+00	---	---	6.2E+00
Isopropylbenzene (Cumene)	3.7E+02	3.0E+03	1.7E+04	4.8E+03	4.0E+04	---	---	3.7E+02	---	---	3.7E+02
Methyl acetate	2.2E+04	4.5E+03	2.4E+03	4.7E+03	1.7E+04	---	---	2.4E+03	---	---	2.4E+03
Methyl iodide	---	5.2E+01	5.7E+00	9.5E+01	3.6E+01	---	---	5.7E+00	---	---	5.7E+00
Methylcyclohexane	1.4E+02	2.2E+04	7.8E+05	2.4E+04	1.2E+04	---	---	1.4E+02	---	---	1.4E+02
Methylene chloride	8.9E+00	2.6E+02	6.5E-01	3.9E+02	2.2E+02	---	---	6.5E-01	---	---	6.5E-01
Naphthalene	1.2E+02	1.2E+02	1.6E+03	1.4E+02	1.3E+03	---	---	1.2E+02	---	---	1.2E+02
n-Butylbenzene	1.4E+02	1.5E+03	6.1E+03	3.4E+03	2.9E+04	---	---	1.4E+02	---	---	1.4E+02
n-Propylbenzene	1.4E+02	1.6E+03	2.2E+03	3.3E+03	1.8E+04	---	---	1.4E+02	---	---	1.4E+02
o-Xylene	2.8E+02	5.6E+03[13]	3.5E+03	5.8E+03[13]	5.7E+04[13]	---	---	2.8E+02	---	---	2.8E+02
sec-Butylbenzene	1.1E+02	1.6E+03	4.2E+03	2.9E+03	2.2E+04	---	---	1.1E+02	---	---	1.1E+02
Styrene	1.7E+03	4.3E+03[13]	1.6E+02	5.8E+03[13]	3.2E+04[13]	---	3.0E+02 +	1.6E+02	---	---	1.6E+02
tert-Butyl methyl ether (MTBE)	1.7E+01	5.9E+02	3.1E+01	7.1E+02	6.6E+02	---	---	1.7E+01	---	---	1.7E+01
tert-Butylbenzene	1.3E+02	1.4E+03	5.0E+03	2.4E+03	1.6E+04	---	---	1.3E+02	---	---	1.3E+02

TABLE 15 - EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA SOILS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 16 of RI/FS Work Plan[2]								Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\ 3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW\text{-}Soil_{Inh\text{-}V}$[7]	EPA Ecological Soil Screening Level[8]	TCEQ Ecological Benchmark[9]	PSV	TCEQ[11]	Site-Specific[12]	
Tetrachloroethene	5.5E-01	9.4E+01[13]	2.5E+00	4.8E+02[13]	3.2E+02[13]	---	---	5.5E-01	---	---	5.5E-01
Toluene	5.2E+02	5.4E+03[13]	4.1E+02	3.2E+04[13]	3.4E+04[13]	---	2.0E+02 +	2.0E+02	---	---	2.0E+02
trans-1,2-Dichloroethene	6.3E+01	3.7E+02[13]	2.5E+01	4.7E+02[13]	2.4E+02[13]	---	---	2.5E+01	---	---	2.5E+01
trans-1,3-Dichloropropene	---	2.6E+01	1.8E+00	4.6E+01	4.8E+01	---	---	1.8E+00	---	---	1.8E+00
trans-1,4-Dichloro-2-butene	---	1.7E-01	---	1.7E-01	6.9E-01	---	---	1.7E-01	---	---	1.7E-01
Trichloroethene	4.3E-02	9.1E+01	1.7E+00	1.1E+02	7.1E+01	---	---	4.3E-02	---	---	4.3E-02
Trichlorofluoromethane	3.9E+02	1.2E+04	6.4E+03	2.2E+04	4.6E+03	---	---	3.9E+02	---	---	3.9E+02
Trichlorotrifluoroethane	5.6E+03	2.2E+05	1.0E+06	2.4E+05	6.5E+04	---	---	5.6E+03	---	---	5.6E+03
Vinyl acetate	4.3E+02	1.5E+03	2.7E+03	1.6E+03	2.0E+03	---	---	4.3E+02	---	---	4.3E+02
Vinyl chloride	4.3E-02	3.4E+00	1.1E+00	2.2E+01[13]	2.7E+00[13]	---	---	4.3E-02	---	---	4.3E-02
Xylene (total)	2.1E+02	3.7E+03[13]	6.1E+03	4.8E+03[13]	8.1E+03[13]	---	---	2.1E+02	---	---	2.1E+02
SVOCs											
1,2Diphenylhydrazine/Azobenzen	6.1E-01	3.6E+01[13]	8.8E+02[13]	7.1E+02[13]	9.4E+04[13]	---	---	6.1E-01	---	---	6.1E-01
2,4,5-Trichlorophenol	6.1E+03	4.1E+03	1.7E+03	1.1E+04	4.1E+05	---	4.0E+00 +	4.0E+00	---	---	4.0E+00
2,4,6-Trichlorophenol	4.4E+01	6.7E+01[13]	8.8E+00[13]	1.0E+03	2.3E+04	---	1.0E+01	8.8E+00	---	---	8.8E+00
2,4-Dichlorophenol	1.8E+02	1.9E+02	1.8E+01	6.8E+03	1.7E+05	---	---	1.8E+01	---	---	1.8E+01
2,4-Dimethylphenol	1.2E+03	8.8E+02	1.6E+02	2.6E+03	7.0E+04	---	---	1.6E+02	---	---	1.6E+02
2,4-Dinitrophenol	1.2E+02	1.3E+02	4.7E+00	---	---	---	2.0E+01 +	4.7E+00	---	---	4.7E+00
2,4-Dinitrotoluene	1.2E+02	6.9E+00	2.7E-01	1.5E+01	3.1E+02	---	---	2.7E-01	---	---	2.7E-01
2,6-Dinitrotoluene	6.1E+01	6.9E+00	2.4E-01	2.2E+01	7.3E+02	---	---	2.4E-01	---	---	2.4E-01
2-Chloronaphthalene	3.9E+03	5.0E+03	3.3E+04	---	---	---	---	3.9E+03	---	---	3.9E+03
2-Chlorophenol	6.4E+01	3.6E+02	8.2E+01	3.2E+03	5.3E+04	---	---	6.4E+01	---	---	6.4E+01
2-Methylnaphthalene	---	2.5E+02	8.5E+02	---	---	---	---	2.5E+02	---	---	2.5E+02
2-Nitroaniline	1.8E+02	1.2E+01[13]	1.1E+01[13]	2.4E+01[13]	7.7E+02[13]	---	---	1.1E+01	---	---	1.1E+01
2-Nitrophenol	---	1.0E+02	6.7E+00	4.1E+02	1.2E+04	---	---	6.7E+00	---	---	6.7E+00
3,3'-Dichlorobenzidine	1.1E+00	1.0E+01	3.1E+00	---	---	---	---	1.1E+00	---	---	1.1E+00
3-Nitroaniline	---	1.9E+01	1.3E+00	4.6E+02	1.6E+04	---	---	1.3E+00	---	---	1.3E+00
4,6-Dinitro-2-methylphenol	---	5.2E+00[13]	2.3E-01[13]	2.4E+01	1.0E+03	---	---	2.3E-01	---	---	2.3E-01
4-Bromophenyl phenyl ether	---	2.7E-01	1.8E+01	5.0E+00	5.9E+02	---	---	2.7E-01	---	---	2.7E-01
4-Chloro-3-methylphenol	---	3.3E+02	2.3E+02	1.8E+04	1.0E+06	---	---	2.3E+02	---	---	2.3E+02
4-Chloroaniline	2.4E+02	2.3E+01[13]	1.0E+00[13]	7.4E+02	2.0E+04	---	---	1.0E+00	---	---	1.0E+00
4-Chlorophenyl phenyl ether	---	1.5E-01	1.6E+00	1.3E+00	4.2E+01	---	---	1.5E-01	---	---	1.5E-01
4-Nitroaniline	---	1.9E+02[13]	5.4E+00[13]	6.2E+02[13]	2.2E+04[13]	---	---	5.4E+00	---	---	5.4E+00
4-Nitrophenol	4.9E+02	5.1E+01	5.0E+00	8.3E+01	3.1E+03	---	7.0E+00	5.0E+00	---	---	5.0E+00
Acenaphthene	3.7E+03	3.0E+03	1.2E+04	---	---	---	2.0E+01 +	2.0E+01	---	---	2.0E+01
Acenaphthylene	---	3.8E+03	2.0E+04	---	---	---	---	3.8E+03	---	---	3.8E+03
Acetophenone	1.7E+03	1.8E+03	4.1E+02	2.5E+03	3.0E+04	---	---	4.1E+02	---	---	4.1E+02
Aniline	8.5E+01	5.9E+01	1.8E+01	6.7E+01	1.6E+03	---	---	1.8E+01	---	---	1.8E+01
Anthracene	2.2E+04	1.8E+04	3.4E+05	---	---	---	---	1.8E+04	---	---	1.8E+04
Atrazine (Aatrex)	2.2E+00	2.1E+01	1.2E+00	1.7E+03	9.8E+04	---	---	1.2E+00	---	---	1.2E+00

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TABLE 15 - EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA SOILS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 16 of RI/FS Work Plan[2]								Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$ [4]	$^{GW}Soil_{Class\ 3}$ [5]	$^{Air}Soil_{Inh\text{-}V}$ [6]	$^{Air}GW\text{-}Soil_{Inh\text{-}V}$ [7]	EPA Ecological Soil Screening Level [8]	TCEQ Ecological Benchmark [9]	PSV	TCEQ[11]	Site-Specific[12]	
Benzaldehyde	6.1E+03	2.4E+02	5.3E+02	2.5E+02	1.4E+03	---	---	2.4E+02	---	---	2.4E+02
Benzidine	2.1E-03	1.3E-02	5.5E-04	3.2E-02	1.2E+00	---	---	5.5E-04	---	---	5.5E-04
Benzo(a)anthracene	6.2E-01	5.6E+00	8.9E+02	1.9E+03	1.0E+06	---	---	6.2E-01	---	---	6.2E-01
Benzo(a)pyrene	6.2E-02	5.6E-01	3.8E+02	4.4E+02	9.6E+05	---	---	6.2E-02	---	---	6.2E-02
Benzo(b)fluoranthene	6.2E-01	5.7E+00	3.0E+03	3.2E+03	1.0E+06	---	---	6.2E-01	---	---	6.2E-01
Benzo(g,h,i)perylene	---	1.8E+03	1.0E+06	---	---	---	---	1.8E+03	---	---	1.8E+03
Benzo(k)fluoranthene	6.2E+00	5.7E+01	3.1E+04	7.8E+04	1.0E+06	---	---	6.2E+00	---	---	6.2E+00
Benzoic acid	1.0E+05	3.5E+02	9.5E+03	3.5E+02	1.3E+04	---	---	3.5E+02	---	---	3.5E+02
Benzyl alcohol	1.8E+04	4.0E+03[13]	1.5E+03[13]	4.6E+03	1.4E+05	---	---	1.5E+03[13]	---	---	1.5E+03[13]
Biphenyl	3.0E+03	1.3E+02	1.3E+04	1.4E+02	2.7E+03	---	6.0E+01 +	6.0E+01	---	---	6.0E+01
Bis(2-Chloroethoxy)methane	---	2.5E+00	5.9E-01	5.8E+00	7.4E+01	---	---	5.9E-01	---	---	5.9E-01
Bis(2-Chloroethyl)ether	2.1E-01	1.4E+00	1.1E-01	1.8E+00	1.5E+01	---	---	1.1E-01	---	---	1.1E-01
Bis(2-Chloroisopropyl)ether	---	4.1E+01	9.5E+00	1.1E+02	8.2E+02	---	---	9.5E+00	---	---	9.5E+00
Bis(2-Ethylhexyl)phthalate	3.5E+01	4.3E+01	8.2E+03	---	---	---	---	3.5E+01	---	---	3.5E+01
Butyl benzyl phthalate	2.4E+02	1.6E+03[13]	1.3E+04[13]	1.3E+04	1.0E+06	---	---	2.4E+02	---	---	2.4E+02
Caprolactam	3.1E+04	1.7E+02	2.3E+03	1.7E+02	6.1E+03	---	---	1.7E+02	---	---	1.7E+02
Carbazole	2.4E+01	2.3E+02	2.3E+02	---	---	---	---	2.4E+01	---	---	2.4E+01
Chrysene	6.2E+01	5.6E+02	7.7E+04	3.0E+05	1.0E+06	---	---	6.2E+01	---	---	6.2E+01
Dibenz(a,h)anthracene	6.2E-02	5.5E-01	7.6E+02	1.0E+03	1.0E+06	---	---	6.2E-02	---	---	6.2E-02
Dibenzofuran	1.5E+02	2.7E+02	1.7E+03	---	---	---	---	1.5E+02	---	---	1.5E+02
Diethyl phthalate	4.9E+04	1.4E+03	7.8E+03	1.5E+03	7.0E+04	---	1.0E+02 +	1.0E+02	---	---	1.0E+02
Dimethyl phthalate	1.0E+05	6.6E+02	3.1E+03	6.7E+02	2.2E+04	---	2.0E+02	2.0E+02	---	---	2.0E+02
Di-n-butyl phthalate	6.1E+03	4.4E+03	1.7E+05	1.5E+04	1.0E+06	---	2.0E+02 +	2.0E+02	---	---	2.0E+02
Di-n-octyl phthalate	2.4E+03	1.3E+03[13]	1.0E+06	2.8E+05[13]	1.0E+06[13]	---	---	1.3E+03[13]	---	---	1.3E+03[13]
Fluoranthene	2.3E+03	2.3E+03	9.6E+04	---	---	---	---	2.3E+03	---	---	2.3E+03
Fluorene	2.6E+03	2.3E+03	1.5E+04	---	---	---	3.0E+01	3.0E+01	---	---	3.0E+01
Hexachlorobenzene	3.0E-01	1.0E+00	5.6E+01	9.8E+00	4.2E+02	---	---	3.0E-01	---	---	3.0E-01
Hexachlorocyclopentadiene	3.7E+02	7.2E+00	9.6E+02	7.3E+00	1.4E+02	---	1.0E+01 +	7.2E+00	---	---	7.2E+00
Hexachloroethane	3.5E+01	6.7E+01	9.2E+01	5.0E+02	6.9E+03	---	---	3.5E+01	---	---	3.5E+01
Indeno(1,2,3-cd)pyrene	6.2E-01	5.7E+00	8.7E+03	1.3E+04	1.0E+06	---	---	6.2E-01	---	---	6.2E-01
Isophorone	5.1E+02	1.2E+03	1.5E+02	1.4E+03	2.1E+04	---	---	1.5E+02	---	---	1.5E+02
Nitrobenzene	2.0E+01	3.4E+01[13]	1.8E+01[13]	3.4E+01[13]	3.4E+02[13]	---	4.0E+01	1.8E+01	---	---	1.8E+01
n-Nitrosodimethylamine	9.5E-03	5.5E-02[13]	1.8E-03[13]	1.0E-01[13]	2.7E+00[13]	---	---	1.8E-03	---	---	1.8E-03
n-Nitrosodi-n-propylamine	7.0E-02	4.0E-01	1.8E-02	---	---	---	---	1.8E-02	---	---	1.8E-02
n-Nitrosodiphenylamine	9.9E+01	5.7E+02	1.4E+02	---	---	---	2.0E+01	2.0E+01	---	---	2.0E+01
o-Cresol	3.1E+03	1.0E+03	3.6E+02	1.5E+03	3.8E+04	---	---	3.6E+02	---	---	3.6E+02
Pentachlorophenol	3.0E+00	2.4E+00	9.2E-01	2.3E+02	1.6E+04	1.8E-03 **	5.0E+00 +	1.8E-03	---	---	1.8E-03
Phenanthrene	---	1.7E+03	2.1E+04	---	---	---	---	1.7E+03	---	---	1.7E+03
Phenol	1.8E+04	1.6E+03	9.6E+02	1.7E+03	4.7E+04	---	3.0E+01	3.0E+01	---	---	3.0E+01
Pyrene	2.3E+03	1.7E+03	5.6E+04	---	---	---	---	1.7E+03	---	---	1.7E+03
Pyridine	6.1E+01	4.8E+01	3.5E+00	1.2E+02	4.1E+01	---	---	3.5E+00	---	---	3.5E+00

TABLE 15 - EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA SOILS[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 16 of RI/FS Work Plan[2]								Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\ 3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW\text{-}Soil_{Inh\text{-}V}$[7]	EPA Ecological Soil Screening Level[8]	TCEQ Ecological Benchmark[9]	PSV	TCEQ[11]	Site-Specific[12]	
Sulfate	---	---	---	---	---	---	---	NV	---	---	NV
Chloride	---	---	---	---	---	---	---	NV	---	---	NV

Notes:

1. All values in mg/kg.
2. Values from Table 16 of RI/FS Work Plan (updated to reflect changes in toxicity data since 2005 where applicable).
3. From EPA's "Region 6 Human Health Medium-Specific Screening Levels 2004-2005". Residential Value.
4. $^{Tot}Soil_{Comb}$ PCL = TCEQ Protective Concentration Level for 30 acre source area Residential total soil combined pathway (includes inhalation; ingestion; dermal pathways).
5. $^{GW}Soil_{Class3}$ PCL = TCEQ Protective Concentration Level for 30 acre source area Residential soil-to-groundwater leaching for Class 3 groundwater pathway.
6. $^{Air}Soil_{Inh\text{-}V}$ PCL = TCEQ Protective Concentration Level for 30 acre source area Residential soil-to-air pathway (inhalation of volatiles and particulates).
7. $^{Air}GW\text{-}Soil_{Inh\text{-}V}$ PCL = TCEQ Protective Concentration Level for 30 acre source area Residential soil and groundwater-to-air pathway (inhalation of volatiles and particulates).
8. From EPA's "Ecological Soil Screening Level". Values indicated with "*" are based on soil Invertebrates. Values indicated with "**" are based on avian wildlife. Values indicated with "***" are based on mammalian wildlife. All other values are based on plants.
9. From Table 3-4 of TCEQ "Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas". Values indicated with "+" are based on plant exposure. All other values are based on earthworm exposure.
10. NV = No Preliminary Screening Value.
11. From 30 TAC 350.51(m)
12. 95% UTL calculated from site-specific background samples.
13. Updated from Table 16 of RI/FS Workplan to reflect changes in toxicity data from 2005 to 2009 indicated in TCEQ PCL tables.
14. Updated from Table 16 of RI/FS Workplan to reflect revised reference dose for iron.

TABLE 16 - DETECTED RI SOIL SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
PHASE I SAMPLES				
SA1SB15	0-0.5	Benzo(a)anthracene	2.28J[2]	0.62
		Benzo(a)pyrene	3.6J	0.062
		Benzo(b)fluoranthene	2.27J	0.62
		Copper	105	61
		Dibenz(a,h)anthracene	0.313	0.062
		Indeno(1,2,3-cd)pyrene	1.39J	0.62
		Lead	208	17.93
		Zinc	877	280
	1-2	Benzo(a)anthracene	4.21J	0.62
		Benzo(a)pyrene	4.88J	0.062
		Benzo(b)fluoranthene	5.34J	0.62
		Copper	73.2	61
		Dibenz(a,h)anthracene	0.817	0.062
		Indeno(1,2,3-cd)pyrene	4.37J	0.62
		Lead	395	17.93
		Zinc	1090	280

TABLE 16 - DETECTED RI SOIL SAMPLE CONCENTRATIONS
EXCEEDING EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[(1)] (mg/kg)
SA2SB16	0-0.5	Benzo(a)anthracene	1.29J	0.62
		Benzo(a)pyrene	1.95J	0.062
		Benzo(b)fluoranthene	2.05J	0.62
		Chromium	40.6	30
		Dibenz(a,h)anthracene	0.347	0.062
		Indeno(1,2,3-cd)pyrene	1.44J	0.62
		Lead	45.8	17.93
	1-2	Aroclor-1254	3.42	0.22
		Benzo(a)anthracene	1.71J	0.62
		Benzo(a)pyrene	2.13J	0.062
		Benzo(b)fluoranthene	2.76J	0.62
		Chromium	45.6	30
		Copper	128	61
		Dibenz(a,h)anthracene	0.322	0.062
		Indeno(1,2,3-cd)pyrene	1.31J	0.62
		Lead	702	17.93
		Molybdenum	10.4	2
		Zinc	525	280

TABLE 16 - DETECTED RI SOIL SAMPLE CONCENTRATIONS
EXCEEDING EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
SA3SB17	0-0.5	Benzo(a)anthracene	2.41J	0.62
		Benzo(a)pyrene	3.41J	0.062
		Benzo(b)fluoranthene	4.66J	0.62
		Copper	207	61
		Dibenz(a,h)anthracene	0.465	0.062
		Indeno(1,2,3-cd)pyrene	1.47J	0.62
		Molybdenum	2.24	2
		Zinc	412	280
	1-2	Aroclor-1254	11.5	0.22
		Benzo(a)pyrene	0.608J	0.062
		Benzo(b)fluoranthene	0.835J	0.62
		Copper	487	61
		Dibenz(a,h)anthracene	0.177	0.062
		Lead	252	17.93
		Mercury	0.85	0.1
		Zinc	865	280
SA4SB18	0-0.5	Aroclor-1254	0.734J+	0.22
		Barium	540J	10
		Benzo(a)pyrene	0.329J	0.062
		Lead	146J	17.93
		Zinc	414	280
SA5SB19	0-0.5	Aroclor-1254	0.457	0.22
		Arsenic	11.5	8.66
		Benzo(a)pyrene	0.371J	0.062
		Lead	152J	17.93
		Molybdenum	2.69J-	2
		Zinc	412	280
SA6SB20	0-0.5	Dibenz(a,h)anthracene	0.132	0.062

TABLE 16 - DETECTED RI SOIL SAMPLE CONCENTRATIONS
EXCEEDING EXTENT EVALUATION COMPARISON VALUES - WESTERN EXTENT OF SOUTH AREA

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
PHASE 2 SAMPLES				
L20SB01	0-0.5	Benzo(a)pyrene	0.283	0.062
	1-2	Lead	19J	17.93
L20SB02	0-0.5	Lead	19.7J	17.93
L20SB04	0-0.5	Copper	73J	61
		Lead	116J	17.93
		Mercury	0.72	0.1
		Zinc	453J	280
L20SB05	0-0.5	Benzo(a)pyrene	0.759	0.062
		Lead	108J	17.93
		Zinc	781J	280
L20SB06	0-0.5	Aroclor-1254	0.836	0.22
		Benzo(a)pyrene	0.394	0.062
		Lead	290J	17.93
		Zinc	942J	280
L20SB07	0-0.5	Aroclor-1254	1.02	0.22
		Benzo(a)pyrene	0.776	0.062
		Dibenz(a,h)anthracene	0.235	0.062
		Lead	985J	17.93
		Zinc	6,510J	280

Notes:
(1) Extent Evaluation Comparison Values from Table 15.
(2) Data qualifiers: J = estimated value; J+ = estimated value, biased high; J- = estimated value, biased low.

TABLE 17 - EXTENT EVALUATION COMPARISON VALUES - EASTERN AND VERTICAL EXTENT IN SOIL[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 15 of RI/FS Work Plan[2]					PSV	Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\ 3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW\text{-}Soil_{Inh\text{-}V}$[7]		TCEQ[9]	Site-Specific[10]	
METALS									
Aluminum	1.0E+05	5.7E+05[11]	1.0E+06	---	---	6.7E+04	3.0E+04	---	6.7E+04
Antimony	4.5E+02	3.1E+02	2.7E+02	---	---	2.7E+02	1.0E+00	---	2.7E+02
Arsenic	1.8E+00	2.0E+02	2.5E+02	---	---	1.8E+00	5.9E+00	8.7E+00	8.7E+00
Barium	7.9E+04	8.9E+04[11]	2.2E+04	---	---	2.2E+04	3.0E+02	4.6E+02	2.2E+04
Beryllium	2.2E+03	2.5E+02	9.2E+01	---	---	9.2E+01	1.5E+00	---	9.2E+01
Boron	1.0E+05	1.9E+05	---	---	---	1.0E+05	3.0E+01	---	1.0E+05
Cadmium	5.6E+02	8.5E+02	7.5E+01	---	---	7.5E+01	---	---	7.5E+01
Chromium	5.0E+02	5.7E+04	1.2E+05	---	---	5.0E+02	3.0E+01	2.4E+01	5.0E+02
Chromium (VI)	7.1E+01	1.0E+03	1.4E+03	---	---	7.1E+01	---	---	7.1E+01
Cobalt	2.1E+03	2.7E+02[11]	9.9E+02[11]	---	---	2.7E+02	7.0E+00	---	2.7E+02
Copper	4.2E+04	3.7E+04	5.2E+04	---	---	3.7E+04	1.5E+01	2.4E+01	3.7E+04
Iron	1.0E+05	---	---	---	---	1.0E+05	1.5E+04	---	1.0E+05
Lead	8.0E+02	1.6E+03	1.5E+02	---	---	1.5E+02	1.5E+01	1.8E+01	1.5E+02
Lithium	2.3E+04	1.9E+03[11]	---	---	---	1.9E+03	---	3.6E+01	1.9E+03
Manganese	3.5E+04	2.4E+04	5.1E+05	---	---	2.4E+04	3.0E+02	6.5E+02	2.4E+04
Mercury	3.4E+02	3.3E+00	3.9E-01	3.3E+00	2.6E+00	3.9E-01	4.0E-02	3.5E-02	3.9E-01
Molybdenum	5.7E+03	4.5E+03	7.3E+03	---	---	4.5E+03	---	7.4E-01	4.5E+03
Nickel	2.3E+04	7.9E+03	2.3E+04	---	---	7.9E+03	1.0E+01	---	7.9E+03
Selenium	5.7E+03	4.7E+03	1.1E+02	---	---	1.1E+02	3.0E-01	---	1.1E+02
Silver	5.7E+03	1.7E+03	7.1E+01	---	---	7.1E+01	---	---	7.1E+01
Strontium	1.0E+05	4.9E+05	9.2E+04	---	---	9.2E+04	1.0E+02	---	9.2E+04
Thallium	---	7.8E+01	8.7E+01	---	---	7.8E+01	9.3E+00	---	7.8E+01
Tin	---	4.0E+05	1.0E+06	---	---	4.0E+05	9.0E-01	---	4.0E+05
Titanium	---	1.0E+06	---	---	---	1.0E+06	2.0E+03	---	1.0E+06
Vanadium	1.1E+03	2.3E+03	5.1E+05	---	---	1.1E+03	5.0E+01	---	1.1E+03
Zinc	1.0E+05	2.5E+05	3.5E+05	---	---	1.0E+05	3.0E+01	2.8E+02	1.0E+05
PESTICIDES									
4,4'-DDD	1.1E+01	1.0E+02	1.5E+03	---	---	1.1E+01	---	---	1.1E+01
4,4'-DDE	7.8E+00	7.3E+01	1.3E+03	---	---	7.8E+00	---	---	7.8E+00
4,4'-DDT	7.8E+00	6.8E+01	1.7E+03	1.0E+03	3.7E+05	7.8E+00	---	---	7.8E+00
Aldrin	1.1E-01	9.7E-01	1.2E+01	7.2E+00	9.2E+02	1.1E-01	---	---	1.1E-01
alpha-BHC	4.0E-01	2.9E+00	8.9E-01	1.2E+01	9.1E+02	4.0E-01	---	---	4.0E-01
alpha-Chlordane	---	5.4E+01	8.3E+04	3.5E+03	1.0E+06	5.4E+01	---	---	5.4E+01
beta-BHC	1.4E+00	1.1E+01	3.2E+00	6.2E+01	7.1E+03	1.4E+00	---	---	1.4E+00
delta-BHC	---	1.2E+01	1.9E+01	8.8E+01	1.3E+04	1.2E+01	---	---	1.2E+01
Dieldrin	1.2E-01	1.1E+00	5.5E+00	2.7E+01	1.2E+04	1.2E-01	---	---	1.2E-01
Endosulfan I	---	1.2E+02	4.6E+03	1.3E+02	5.2E+04	1.2E+02	---	---	1.2E+02
Endosulfan II	---	4.1E+03	1.4E+04	---	---	4.1E+03	---	---	4.1E+03

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TABLE 17 - EXTENT EVALUATION COMPARISON VALUES - EASTERN AND VERTICAL EXTENT IN SOIL[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 15 of RI/FS Work Plan[2]					PSV	Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\ 3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW\text{-}Soil_{Inh\text{-}V}$[7]		TCEQ[9]	Site-Specific[10]	
Endosulfan sulfate	---	4.1E+03	7.0E+05	---	---	4.1E+03	---	---	4.1E+03
Endrin	2.1E+02	1.3E+02	3.8E+01	3.4E+02	1.1E+05	3.8E+01	---	---	3.8E+01
Endrin aldehyde	---	2.0E+02	9.4E+04	---	---	2.0E+02	---	---	2.0E+02
Endrin ketone	---	1.8E+02	7.6E+03	1.4E+03	1.0E+06	1.8E+02	---	---	1.8E+02
gamma-BHC (Lindane)	1.9E+00	1.8E+01	4.6E-01	4.2E+02	3.5E+04	4.6E-01	---	---	4.6E-01
gamma-Chlordane	---	5.1E+01	4.6E+03	8.4E+02	2.6E+05	5.1E+01	---	---	5.1E+01
Heptachlor	4.3E-01	2.8E+00	9.4E+00	7.9E+00	3.2E+02	4.3E-01	---	---	4.3E-01
Heptachlor epoxide	2.1E-01	1.9E+00	2.9E+00	2.1E+01	3.8E+03	2.1E-01	---	---	2.1E-01
Methoxychlor	3.4E+03	3.0E+03	6.2E+03	2.2E+04	1.0E+06	3.0E+03	---	---	3.0E+03
Toxaphene	1.7E+00	1.7E+01	5.8E+02	8.3E+02	7.5E+05	1.7E+00	---	---	1.7E+00
PCBs	---	7.1E+00	5.3E+02	4.7E+01	6.8E+03	7.1E+00	---	---	7.1E+00
Aroclor-1016	2.4E+01	---	---	---	---	2.4E+01	---	---	2.4E+01
Aroclor-1221	8.3E-01	---	---	---	---	8.3E-01	---	---	8.3E-01
Aroclor-1232	8.3E-01	---	---	---	---	8.3E-01	---	---	8.3E-01
Aroclor-1242	8.3E-01	---	---	---	---	8.3E-01	---	---	8.3E-01
Aroclor-1248	8.3E-01	---	---	---	---	8.3E-01	---	---	8.3E-01
Aroclor-1254	8.3E-01	---	---	---	---	8.3E-01	---	---	8.3E-01
Aroclor-1260	8.3E-01	---	---	---	---	8.3E-01	---	---	8.3E-01
VOCs									
1,1,1,2-Tetrachloroethane	7.6E+00	7.3E+01[11]	1.6E+02[11]	7.8E+01[11]	4.9E+02[11]	7.6E+00	---	---	7.6E+00
1,1,1-Trichloroethane	1.4E+03	5.4E+04[11]	8.1E+01	5.5E+04[11]	2.9E+04[11]	8.1E+01	---	---	8.1E+01
1,1,2,2-Tetrachloroethane	9.7E-01	7.3E+00	2.6E+00	7.7E+00	2.4E+01	9.7E-01	---	---	9.7E-01
1,1,2-Trichloroethane	2.1E+00	1.9E+01	1.0E+00	1.9E+01	3.5E+01	1.0E+00	---	---	1.0E+00
1,1-Dichloroethane	2.3E+03	4.3E+03[11]	2.8E+03[11]	4.4E+03	2.5E+03	2.3E+03	---	---	2.3E+03
1,1-Dichloroethene	4.7E+02	3.5E+03[11]	2.5E+00	3.8E+03[11]	1.1E+03[11]	2.5E+00	---	---	2.5E+00
1,1-Dichloropropene	---	6.1E+01	1.5E+01	7.7E+01	3.1E+01	1.5E+01	---	---	1.5E+01
1,2,3-Trichloropropane	3.4E-03	4.1E+00	2.6E-01	2.0E+03	1.0E+04	3.4E-03	---	---	3.4E-03
1,2,4-Trichlorobenzene	2.6E+02	4.2E+03[11]	2.4E+02	1.1E+04[11]	9.7E+04[11]	2.4E+02	---	---	2.4E+02
1,2,4-Trimethylbenzene	1.9E+02	1.1E+02[11]	7.2E+03	1.1E+02[11]	6.8E+02[11]	1.1E+02	---	---	1.1E+02
1,2-Dibromo-3-chloropropane	2.2E+00	1.4E-01[11]	8.7E-02	1.4E-01[11]	5.9E-01[11]	8.7E-02	---	---	8.7E-02
1,2-Dibromoethane	7.0E-02	7.9E-01[11]	1.0E-02	8.4E-01[11]	2.5E+00[11]	1.0E-02	---	---	1.0E-02
1,2-Dichlorobenzene	3.7E+02	5.7E+02	8.9E+02	1.8E+03[11]	9.1E+03[11]	3.7E+02	---	---	3.7E+02
1,2-Dichloroethane	8.4E-01	1.1E+01	6.9E-01	1.2E+01	9.8E+00	6.9E-01	---	---	6.9E-01
1,2-Dichloropropane	8.5E-01	4.4E+01	1.1E+00	4.4E+01	4.8E+01	8.5E-01	---	---	8.5E-01
1,3,5-Trimethylbenzene	7.8E+01	8.3E+01	7.9E+03	8.3E+01	5.0E+02	7.8E+01	---	---	7.8E+01
1,3-Dichlorobenzene	1.5E+02	8.8E+01	1.0E+03	8.8E+01	1.6E+02	8.8E+01	---	---	8.8E+01
1,3-Dichloropropane	---	6.1E+01	7.2E+00	7.7E+01	2.0E+02	7.2E+00	---	---	7.2E+00
1,4-Dichlorobenzene	8.1E+00	1.2E+03	1.1E+02	1.3E+04	6.6E+04	8.1E+00	---	---	8.1E+00

TABLE 17 - EXTENT EVALUATION COMPARISON VALUES - EASTERN AND VERTICAL EXTENT IN SOIL[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 15 of RI/FS Work Plan[2]					PSV	Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\ 3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW Soil_{Inh\text{-}V}$[7]		TCEQ[9]	Site-Specific[10]	
2,2-Dichloropropane	---	4.4E+01	1.4E+01	4.4E+01	4.6E+01	1.4E+01	---	---	1.4E+01
2-Butanone	3.4E+04	7.3E+04	4.4E+03	8.2E+04	4.9E+05	4.4E+03	---	---	4.4E+03
2-Chloroethylvinyl ether	---	3.3E+00	3.2E-01	3.3E+00	6.2E+00	3.2E-01	---	---	3.2E-01
2-Chlorotoluene	5.1E+02	2.5E+03	1.4E+03	3.1E+03	1.3E+04	5.1E+02	---	---	5.1E+02
2-Hexanone	---	7.9E+01	5.8E+02	7.9E+01	3.7E+02	7.9E+01	---	---	7.9E+01
4-Chlorotoluene	---	3.5E+00	5.7E+03[11]	3.5E+00	1.6E+01	3.5E+00	---	---	3.5E+00
4-Isopropyltoluene	---	4.7E+03	3.5E+04	4.9E+03	3.9E+04	4.7E+03	---	---	4.7E+03
4-Methyl-2-pentanone	1.7E+04	2.8E+04	7.4E+02	4.2E+04	1.5E+05	7.4E+02	---	---	7.4E+02
Acetone	1.0E+05	8.1E+03	6.4E+03	8.2E+03	4.5E+04	6.4E+03	---	---	6.4E+03
Acrolein	3.8E-01	8.1E-01	3.5E+00	8.1E-01	1.2E+01	3.8E-01	---	---	3.8E-01
Acrylonitrile	5.5E-01	4.2E+00	3.7E-01	4.6E+00	1.2E+01	3.7E-01	---	---	3.7E-01
Benzene	1.6E+00	1.11E+02[11]	1.3E+00	1.41E+02[11]	1.00E+02[11]	1.3E+00	---	---	1.3E+00
Bromobenzene	1.2E+02	1.2E+02[11]	8.6E+02	1.2E+02[11]	4.0E+02[11]	1.2E+02	---	---	1.2E+02
Bromodichloromethane	2.6E+00	4.6E+02	7.3E+00	---	---	2.6E+00	---	---	2.6E+00
Bromoform	2.4E+02	6.0E+02	7.1E+01	7.2E+02	3.1E+03	7.1E+01	---	---	7.1E+01
Bromomethane	1.5E+01	5.3E+01	2.0E+01	5.5E+01	1.6E+01	1.5E+01	---	---	1.5E+01
Butanol	6.8E+04	3.1E+03	7.9E+02	3.2E+03	3.8E+04	7.9E+02	---	---	7.9E+02
Carbon disulfide	7.2E+02	7.2E+03	2.0E+03	7.7E+03	2.4E+03	7.2E+02	---	---	7.2E+02
Carbon tetrachloride	5.8E-01	1.9E+01	3.1E+00	2.1E+01	1.1E+01	5.8E-01	---	---	5.8E-01
Chlorobenzene	6.0E+02	5.4E+02[11]	5.5E+01	5.5E+02[11]	1.1E+03[11]	5.5E+01	---	---	5.5E+01
Chloroethane	7.2E+00	8.7E+04	4.6E+03	1.1E+05	3.3E+04	7.2E+00	---	---	7.2E+00
Chloroform	5.8E-01	1.3E+01	1.5E+02	1.3E+01	9.0E+00	5.8E-01	---	---	5.8E-01
Chloromethane	3.0E+00	1.6E+02	4.5E+01	1.7E+02	2.3E+01	3.0E+00	---	---	3.0E+00
cis-1,2-Dichloroethene	1.6E+02	4.7E+03	1.2E+01	8.8E+03	5.2E+03	1.2E+01	---	---	1.2E+01
cis-1,3-Dichloropropene	---	4.3E+01	7.4E-01	7.4E+01	8.2E+01	7.4E-01	---	---	7.4E-01
Cyclohexane	6.8E+03	4.2E+04	2.9E+05	4.7E+04	1.8E+04	6.8E+03	---	---	6.8E+03
Dibromochloromethane	2.6E+00	3.4E+02	5.5E+00	---	---	2.6E+00	---	---	2.6E+00
Dibromomethane	5.9E+02	1.9E+02	1.3E+02	1.9E+02	6.6E+02	1.3E+02	---	---	1.3E+02
Dichlorodifluoromethane	3.4E+02	4.3E+04	3.6E+04	5.5E+04	1.3E+04	3.4E+02	---	---	3.4E+02
Ethylbenzene	2.3E+02	1.0E+04	3.8E+02	1.1E+04	1.5E+04	2.3E+02	---	---	2.3E+02
Hexachlorobutadiene	2.5E+01	2.3E+01	3.7E+02[11]	2.5E+01	2.7E+02	2.3E+01	---	---	2.3E+01
Isopropylbenzene (Cumene)	5.8E+02	6.3E+03	5.2E+04	6.7E+03	5.7E+04	5.8E+02	---	---	5.8E+02
Methyl acetate	1.0E+05	6.6E+03	7.3E+03	6.6E+03	2.4E+04	6.6E+03	---	---	6.6E+03
Methyl iodide	---	1.2E+02	1.7E+01	1.3E+02	5.1E+01	1.7E+01	---	---	1.7E+01
Methylcyclohexane	1.4E+02	3.3E+04	1.0E+06	3.3E+04	1.6E+04	1.4E+02	---	---	1.4E+02
Methylene chloride	2.2E+01	5.6E+02	6.5E-01	6.6E+02	3.6E+02	6.5E-01	---	---	6.5E-01
Naphthalene	2.1E+02	1.9E+02	4.7E+03	1.9E+02	1.8E+03	1.9E+02	---	---	1.9E+02
n-Butylbenzene	2.4E+02	4.0E+03	1.8E+04	4.7E+03	4.1E+04	2.4E+02	---	---	2.4E+02
n-Propylbenzene	2.4E+02	4.1E+03	6.7E+03	4.6E+03	2.5E+04	2.4E+02	---	---	2.4E+02

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TABLE 17 - EXTENT EVALUATION COMPARISON VALUES - EASTERN AND VERTICAL EXTENT IN SOIL[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 15 of RI/FS Work Plan[2]					PSV	Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\ 3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW Soil_{Inh\text{-}V}$[7]		TCEQ[9]	Site-Specific[10]	
o-Xylene	2.8E+02	8.0E+03[11]	3.5E+03	8.1E+03[11]	8.0E+04[11]	2.8E+02	---	---	2.8E+02
sec-Butylbenzene	2.2E+02	3.7E+03	1.3E+04	4.1E+03	3.0E+04	2.2E+02	---	---	2.2E+02
Styrene	1.7E+03	7.8E+03[11]	1.6E+02	8.1E+03[11]	4.5E+04[11]	1.6E+02	---	---	1.6E+02
tert-Butyl methyl ether (MTBE)	4.1E+01	1.1E+03	9.3E+01	1.2E+03	1.1E+03	4.1E+01	---	---	4.1E+01
tert-Butylbenzene	3.9E+02	3.2E+03	1.5E+04	3.4E+03	2.3E+04	3.9E+02	---	---	3.9E+02
Tetrachloroethene	1.7E+00	3.3E+02[11]	2.5E+00	8.1E+02[11]	5.4E+02[11]	1.7E+00	---	---	1.7E+00
Toluene	5.2E+02	2.9E+04[11]	4.1E+02	4.5E+04[11]	4.7E+04[11]	4.1E+02	---	---	4.1E+02
trans-1,2-Dichloroethene	2.4E+02	6.42E+02[11]	2.5E+01	6.63E+02[11]	3.41E+02[11]	2.5E+01	---	---	2.5E+01
trans-1,3-Dichloropropene	---	6.1E+01	4.0E+00	7.7E+01	8.1E+01	4.0E+00	---	---	4.0E+00
trans-1,4-Dichloro-2-butene	---	2.9E-01	---	2.9E-01	1.2E+00	2.9E-01	---	---	2.9E-01
Trichloroethene	1.0E-01	1.1E+02[11]	1.7E+00	1.1E+02[11]	7.2E+02[11]	1.0E-01	---	---	1.0E-01
Trichlorofluoromethane	1.4E+03	2.8E+04	1.9E+04	3.1E+04	6.4E+03	1.4E+03	---	---	1.4E+03
Trichlorotrifluoroethane	5.6E+03	3.3E+05	1.0E+06	3.3E+05	9.0E+04	5.6E+03	---	---	5.6E+03
Vinyl acetate	1.6E+03	2.2E+03	8.0E+03	2.2E+03	2.8E+03	1.6E+03	---	---	1.6E+03
Vinyl chloride	4.3E-01	1.3E+01[11]	1.1E+00	3.7E+01[11]	4.6E+00[11]	4.3E-01	---	---	4.3E-01
Xylene (total)	2.1E+02	6.5E+03[11]	6.1E+03	6.7E+03[11]	1.1E+04[11]	2.1E+02	---	---	2.1E+02
SVOCs									
1,2Diphenylhydrazine/Azobenzen	2.4E+00	1.5E+02[11]	2.0E+03[11]	1.2E+03[11]	1.6E+05[11]	2.4E+00	---	---	2.4E+00
2,4,5-Trichlorophenol	6.8E+04	1.2E+04	5.1E+03	1.5E+04	5.7E+05	5.1E+03	---	---	5.1E+03
2,4,6-Trichlorophenol	1.7E+02	6.81E+02[11]	2.61E+01[11]	1.7E+03	3.8E+04	2.6E+01	---	---	2.6E+01
2,4-Dichlorophenol	2.1E+03	1.7E+03	5.3E+01	9.6E+03	2.4E+05	5.3E+01	---	---	5.3E+01
2,4-Dimethylphenol	1.4E+04	2.9E+03	4.8E+02	3.6E+03	9.8E+04	4.8E+02	---	---	4.8E+02
2,4-Dinitrophenol	1.4E+03	1.4E+03	1.4E+01	---	---	1.4E+01	---	---	1.4E+01
2,4-Dinitrotoluene	1.4E+03	2.1E+01	6.0E-01	2.1E+01	4.4E+02	6.0E-01	---	---	6.0E-01
2,6-Dinitrotoluene	6.8E+02	2.8E+01	5.4E-01	3.1E+01	1.0E+03	5.4E-01	---	---	5.4E-01
2-Chloronaphthalene	2.6E+04	5.0E+04	1.0E+05	---	---	2.6E+04	---	---	2.6E+04
2-Chlorophenol	2.6E+02	2.4E+03	2.4E+02	4.5E+03	7.4E+04	2.4E+02	---	---	2.4E+02
2-Methylnaphthalene	---	2.5E+03	2.5E+03	---	---	2.5E+03	---	---	2.5E+03
2-Nitroaniline	2.0E+03	2.9E+01[11]	3.3E+00[11]	3.4E+01[11]	1.1E+03[11]	3.3E+00	---	---	3.3E+00
2-Nitrophenol	---	4.1E+02	2.0E+01	5.8E+02	1.7E+04	2.0E+01	---	---	2.0E+01
3,3'-Dichlorobenzidine	4.3E+00	4.2E+01	7.0E+00	---	---	4.3E+00	---	---	4.3E+00
3-Nitroaniline	---	1.6E+02	3.8E+00	6.4E+02	2.3E+04	3.8E+00	---	---	3.8E+00
4,6-Dinitro-2-methylphenol	---	2.26E+01[11]	7.0E-01[11]	3.4E+01	1.5E+03	7.0E-01	---	---	7.0E-01
4-Bromophenyl phenyl ether	---	1.1E+00	4.0E+01	8.4E+00	1.0E+03	1.1E+00	---	---	1.1E+00
4-Chloro-3-methylphenol	---	3.0E+03	6.8E+02	2.5E+04	1.0E+06	6.8E+02	---	---	6.8E+02
4-Chloroaniline	2.7E+03	9.5E+01[11]	2.3E+00[11]	1.0E+03	2.8E+04	2.3E+00	---	---	2.3E+00
4-Chlorophenyl phenyl ether	---	8.0E-01	3.6E+00	2.2E+00	7.0E+01	8.0E-01	---	---	8.0E-01

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TABLE 17 - EXTENT EVALUATION COMPARISON VALUES - EASTERN AND VERTICAL EXTENT IN SOIL[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 15 of RI/FS Work Plan[2]					PSV	Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	$^{Tot}Soil_{Comb}$[4]	$^{GW}Soil_{Class\ 3}$[5]	$^{Air}Soil_{Inh\text{-}V}$[6]	$^{Air}GW\text{-}Soil_{Inh\text{-}V}$[7]		TCEQ[9]	Site-Specific[10]	
4-Nitroaniline	---	6.6E+02[11]	1.2E+01[11]	8.7E+02[11]	3.1E+04[11]	1.2E+01	---	---	1.2E+01
4-Nitrophenol	5.5E+03	1.1E+02	1.5E+01	1.2E+02	4.4E+03	1.5E+01	---	---	1.5E+01
Acenaphthene	3.3E+04	3.7E+04	3.5E+04	---	---	3.3E+04	---	---	3.3E+04
Acenaphthylene	---	3.7E+04	6.1E+04	---	---	3.7E+04	---	---	3.7E+04
Acetophenone	1.7E+03	3.3E+03	1.2E+03	3.5E+03	4.1E+04	1.2E+03	---	---	1.2E+03
Aniline	3.4E+02	9.3E+01	4.1E+01	9.4E+01	2.3E+03	4.1E+01	---	---	4.1E+01
Anthracene	1.0E+05	1.9E+05	1.0E+06	---	---	1.0E+05	---	---	1.0E+05
Atrazine (Aatrex)	8.6E+00	8.6E+01	1.2E+00	2.4E+03	1.4E+05	1.2E+00	---	---	1.2E+00
Benzaldehyde	6.8E+04	3.4E+02	1.6E+03	3.5E+02	2.0E+03	3.4E+02	---	---	3.4E+02
Benzidine	8.3E-03	3.3E-02	1.2E-03	5.4E-02	1.9E+00	1.2E-03	---	---	1.2E-03
Benzo(a)anthracene	2.3E+00	2.4E+01	2.0E+03	3.2E+03	1.0E+06	2.3E+00	---	---	2.3E+00
Benzo(a)pyrene	2.3E-01	2.4E+00	3.8E+02	7.3E+02	1.0E+06	2.3E-01	---	---	2.3E-01
Benzo(b)fluoranthene	2.3E+00	2.4E+01	6.7E+03	5.3E+03	1.0E+06	2.3E+00	---	---	2.3E+00
Benzo(g,h,i)perylene	---	1.9E+04	1.0E+06	---	---	1.9E+04	---	---	1.9E+04
Benzo(k)fluoranthene	2.3E+01	2.4E+02	6.9E+04	1.3E+05	1.0E+06	2.3E+01	---	---	2.3E+01
Benzoic acid	1.0E+05	5.0E+02	2.8E+04	5.0E+02	1.8E+04	5.0E+02	---	---	5.0E+02
Benzyl alcohol	1.0E+05	6.2E+03	4.4E+03[11]	6.4E+03	2.0E+05	4.4E+03	---	---	4.4E+03
Biphenyl	2.6E+04	1.9E+02	3.8E+04	1.9E+02	3.8E+03	1.9E+02	---	---	1.9E+02
Bis(2-Chloroethoxy)methane	---	6.2E+00	1.3E+00	9.8E+00	1.2E+02	1.3E+00	---	---	1.3E+00
Bis(2-Chloroethyl)ether	6.2E-01	2.8E+00	2.4E-01	3.1E+00	2.6E+01	2.4E-01	---	---	2.4E-01
Bis(2-Chloroisopropyl)ether	---	1.1E+02	2.1E+01	1.8E+02	1.4E+03	2.1E+01	---	---	2.1E+01
Bis(2-Ethylhexyl)phthalate	1.4E+02	5.6E+02	8.2E+03	---	---	1.4E+02	---	---	1.4E+02
Butyl benzyl phthalate	2.4E+02	1.0E+04[11]	3.0E+04[11]	1.8E+04	1.0E+06	2.4E+02	---	---	2.4E+02
Caprolactam	1.0E+05	2.3E+02	7.0E+03	2.3E+02	8.5E+03	2.3E+02	---	---	2.3E+02
Carbazole	9.6E+01	9.5E+02	5.1E+02	---	---	9.6E+01	---	---	9.6E+01
Chrysene	2.3E+02	2.4E+03	1.7E+05	5.1E+05	1.0E+06	2.3E+02	---	---	2.3E+02
Dibenz(a,h)anthracene	2.3E-01	2.4E+00	1.1E+03	1.7E+03	1.0E+06	2.3E-01	---	---	2.3E-01
Dibenzofuran	1.7E+03	2.7E+03	5.0E+03	---	---	1.7E+03	---	---	1.7E+03
Diethyl phthalate	1.0E+05	2.0E+03	2.3E+04	2.1E+03	9.8E+04	2.0E+03	---	---	2.0E+03
Dimethyl phthalate	1.0E+05	9.3E+02	9.3E+03	9.3E+02	3.0E+04	9.3E+02	---	---	9.3E+02
Di-n-butyl phthalate	6.8E+04	1.6E+04	5.0E+05	2.1E+04	1.0E+06	1.6E+04	---	---	1.6E+04
Di-n-octyl phthalate	2.7E+04	1.3E+04[11]	1.0E+06	3.9E+05[11]	1.0E+06[11]	1.3E+04	---	---	1.3E+04
Fluoranthene	2.4E+04	2.5E+04	2.9E+05	---	---	2.4E+04	---	---	2.4E+04
Fluorene	2.6E+04	2.5E+04	4.5E+04	---	---	2.5E+04	---	---	2.5E+04
Hexachlorobenzene	1.2E+00	6.9E+00	5.6E+01	1.6E+01	7.0E+02	1.2E+00	---	---	1.2E+00
Hexachlorocyclopentadiene	4.1E+03	1.0E+01	9.6E+02	1.0E+01	1.9E+02	1.0E+01	---	---	1.0E+01
Hexachloroethane	1.4E+02	5.2E+02	2.7E+02	8.3E+02	1.2E+04	1.4E+02	---	---	1.4E+02
Indeno(1,2,3-cd)pyrene	2.3E+00	2.4E+01	1.9E+04	2.2E+04	1.0E+06	2.3E+00	---	---	2.3E+00
Isophorone	2.0E+03	1.9E+03	3.4E+02	1.9E+03	2.9E+04	3.4E+02	---	---	3.4E+02

TABLE 17 - EXTENT EVALUATION COMPARISON VALUES - EASTERN AND VERTICAL EXTENT IN SOIL[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 15 of RI/FS Work Plan[2]					PSV	Potential Background Values		Extent Evaluation Comparison Value
	EPA Region 6 Soil Screening Criteria[3]	${}^{Tot}Soil_{Comb}$[4]	${}^{GW}Soil_{Class\ 3}$[5]	${}^{Air}Soil_{Inh-V}$[6]	${}^{Air}GW\text{-}Soil_{Inh-V}$[7]		TCEQ[9]	Site-Specific[10]	
Nitrobenzene	1.1E+02	5.7E+01[11]	5.2E+01[11]	5.7E+01[11]	5.6E+02[11]	5.2E+01	---	---	5.2E+01
n-Nitrosodimethylamine	3.8E-02	1.3E-01	4.1E-03	1.7E-01	4.5E+00	4.1E-03	---	---	4.1E-03
n-Nitrosodi-n-propylamine	2.7E-01	1.4E+00	3.9E-02	---	---	3.9E-02	---	---	3.9E-02
n-Nitrosodiphenylamine	3.9E+02	1.9E+03	3.2E+02	---	---	3.2E+02	---	---	3.2E+02
o-Cresol	3.4E+04	1.9E+03	1.1E+03	2.0E+03	5.3E+04	1.1E+03	---	---	1.1E+03
Pentachlorophenol	1.0E+01	1.1E+02	9.2E-01	3.3E+02	2.2E+04	9.2E-01	---	---	9.2E-01
Phenanthrene	---	1.9E+04	6.2E+04	---	---	1.9E+04	---	---	1.9E+04
Phenol	1.0E+05	2.4E+03	2.9E+03	2.4E+03	6.5E+04	2.4E+03	---	---	2.4E+03
Pyrene	3.2E+04	1.9E+04	1.7E+05	---	---	1.9E+04	---	---	1.9E+04
Pyridine	6.8E+02	1.4E+02	1.0E+01	1.7E+02	5.7E+01	1.0E+01	---	---	1.0E+01
Sulfate	---	---	---	---	---	NV	---	---	NV
Chloride	---	---	---	---	---	NV	---	---	NV

Notes:

1. All values in mg/kg.
2. Values from Table 15 of RI/FS Work Plan (updated to reflect changes in toxicity data since 2005 where applicable).
3. From EPA's "Region 6 Human Health Medium-Specific Screening Levels 2004-2005". Industrial Outdoor Worker.
4. ${}^{Tot}Soil_{Comb}$ PCL = TCEQ Protective Concentration Level for 30 acre source area, Commercial/Industrial total soil combined pathway (includes inhalation; ingestion; dermal pathways).
5. ${}^{GW}Soil_{Class3}$ PCL = TCEQ Protective Concentration Level for 30 acre source area, Commercial/Industrial soil-to-groundwater leaching for Class 3 groundwater pathway.
6. ${}^{Air}Soil_{Inh-V}$ PCL = TCEQ Protective Concentration Level for 30 acre source area, Commercial/Industrial soil-to-air pathway (inhalation of volatiles and particulates).
7. ${}^{Air}GW\text{-}Soil_{Inh-V}$ PCL = TCEQ Protective Concentration Level for 30 acre source area, Commercial/Industrial soil and groundwater-to-air pathway (inhalation of volatiles and particulates).
8. NV = No Preliminary Screening Value.
9. From 30 TAC 350.51(m)
10. 95% UTL calculated from site-specific background samples.
11. Updated from Table 15 of RI/FS Workplan to reflect changes in toxicity data from 2005 to 2009 indicated in TCEQ PCL tables.

TABLE 18 - DETECTED RI SOIL SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES - VERTICAL EXTENT OF SOUTH AREA

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value(1) (mg/kg)
SA1SB15	1-2	Benzo(a)anthracene	4.21J(2)	2.3
		Benzo(a)pyrene	4.88J	0.23
		Benzo(b)fluoranthene	5.34J	2.3
		Dibenz(a,h)anthracene	0.817	0.23
		Indeno(1,2,3-cd)pyrene	4.37J	2.3
		Lead	395	151
SA2SB16	1-2	Aroclor-1254	3.42	0.83
		Benzo(a)pyrene	2.13J	0.23
		Benzo(b)fluoranthene	2.76J	2.3
		Dibenz(a,h)anthracene	0.322	0.23
		Lead	702	151
SA3SB17	1-2	Aroclor-1254	11.5	0.83
		Benzo(a)pyrene	0.608J	0.23
		Lead	252	151
		Mercury	0.85	0.391
SB2SB22	1-2	Aroclor-1254	2.84	0.83
		Benzo(a)pyrene	0.38J	0.23
SB4SB24	1-2	Aroclor-1254	2.73	0.83
		Benzo(a)pyrene	1.37J	0.23
		Dibenz(a,h)anthracene	0.324	0.23
SC3SB27	1-2	Dibenz(a,h)anthracene	0.606	0.23
SC4SB28	1-2	Benzo(a)pyrene	1.2J	0.23
		Lead	192J	151
SD3SB33	1-2	Benzo(a)pyrene	0.509J	0.23
SD5SB35	1-2	Aroclor-1254	1.41	0.83
		Benzo(a)anthracene	4.79	2.3
		Benzo(a)pyrene	4.45J	0.23
		Benzo(b)fluoranthene	5.97	2.3
		Dibenz(a,h)anthracene	1.23	0.23
		Indeno(1,2,3-cd)pyrene	2.79J	2.3
		Mercury	0.5	0.391
SF2SB44	1-2	Dibenz(a,h)anthracene	0.354J	0.23
SF3SB45	1-2	Arsenic	9.58	8.66
		Benzo(a)pyrene	0.966J	0.23
SF4SB46	1-2	Benzo(a)pyrene	0.921J	0.23
SG4SB56	1-2	Benzo(a)pyrene	0.248J	0.23
SG6SB59	1-2	Benzo(a)pyrene	0.276J	0.23
SI1SB69	1-2	Arsenic	9.38	8.66

Notes:
(1) Extent Evaluation Comparison Values from Table 17.
(2) Data qualifiers: J = estimated value.

TABLE 19 - SOUTH AREA PHASE 2 RI DEEP SOIL SAMPLE DATA

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
SA1SB15	4-5	Benzo(a)anthracene	<0.00504	2.3
		Benzo(a)pyrene	0.0269 J[2]	0.23
		Benzo(b)fluoranthene	0.0281 J	2.3
		Dibenz(a,h)anthracene	<0.00655	0.23
		Indeno(1,2,3-cd)pyrene	0.0236 J	2.3
		Lead	12.1	151
SA2SB16	4-5	Aroclor-1254	<0.00579	0.83
		Benzo(a)pyrene	<0.00866	0.23
		Benzo(b)fluoranthene	<0.0118	2.3
		Dibenz(a,h)anthracene	<0.00661	0.23
		Lead	7.88	151
SA3SB17	4-5	Aroclor-1254	<0.00614	0.83
		Benzo(a)pyrene	<0.00928	0.23
		Lead	11.7	151
		Mercury	<0.024	0.391
SB2SB22	4-5	Aroclor-1254	0.0769	0.83
		Benzo(a)pyrene	<0.00986	0.23
SB4SB24	4-5	Aroclor-1254	0.0203 J	0.83
		Benzo(a)pyrene	0.0311 J	0.23
		Dibenz(a,h)anthracene	<0.00734	0.23
SC3SB27	4-5	Dibenz(a,h)anthracene	<0.0068	0.23
SC4SB28	4-5	Benzo(a)pyrene	<0.00899	0.23
		Lead	11.3	151
SD3SB33	4-5	Benzo(a)pyrene	<0.00924	0.23
SD5SB35	4-5	Aroclor-1254	<0.00648	0.83
		Benzo(a)anthracene	<0.00567	2.3
		Benzo(a)pyrene	<0.00966	0.23
		Benzo(b)fluoranthene	<0.0132	2.3
		Dibenz(a,h)anthracene	<0.00737	0.23
		Indeno(1,2,3-cd)pyrene	<0.0141	2.3
		Mercury	<0.028	0.391
SF2SB44	4-5	Dibenz(a,h)anthracene	<0.00752	0.23
SF3SB45	4-5	Arsenic	0.25 J	8.66
		Benzo(a)pyrene	<0.00935	0.23
SF4SB46	4-5	Benzo(a)pyrene	<0.00949	0.23
SG4SB56	4-5	Benzo(a)pyrene	<0.00965	0.23
SG6SB59	4-5	Benzo(a)pyrene	<0.00906	0.23
SI1SB69	4-5	Arsenic	<0.13	8.66

Notes:
(1) Extent Evaluation Comparison Values from Table 17.
(2) Data qualifiers: J = estimated value.

TABLE 20 - LOT 19 / 20 SOIL SAMPLE LEAD CONCENTRATIONS

Sample ID	Lead Concentration (mg/kg)
L19SS01	17.3
L19SS02	18.8
L19SS03	11.2
L19SS04	8.87
L19SS05	12.0
L19SS06	19.3
L19SS07	12.8
L19SS08	12.8
L19SS09	55.3
L19SS10	17.1
L19SS11	12.1
L19SS12	13.5
L19SS13	16.7
L19SS14	16.0
L19SS15	23.2
L19SS16	18.8
L19SS17	175
L20SS01	10.8
L20SS02	222
L20SS03	23.1
L20SS04	462
L20SS05	8.61
L20SS06	23.8
L20SS07	129
L20SS08	73.6
L20SS09	84.3
L20SS10	253

Notes:

1. Data Qualifiers: none.

TABLE 21 - DETECTED RI SOIL SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES - VERTICAL EXTENT OF NORTH AREA

Sample Location	Sample Depth (ft below ground surface)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
ND3SB04	1-2	1,2,3-Trichloropropane	0.168	0.0014
		Trichloroethene	0.537	0.043
	4-5	1,2,3-Trichloropropane	0.0472	0.0014
		Trichloroethene	0.29J[2]	0.043
NE3SB09	0-0.5	Benzo(a)pyrene	1.42J	0.062
		Dibenz(a,h)anthracene	0.404J-	0.062
SB-202	0-0.5	Iron	102,000	53,000
		Lead	471	18
SB-203	1.5-2	Benzo(a)pyrene	0.939	0.062
SB-204	1.5-2	Aroclor-1254	6.35J	0.22
SB-205	3-4	Iron	128,000	53,000
		Lead	630	18
SB-206	5-6	Arsenic	8.95	8.7

Notes:
(1) Extent Evaluation Comparison Values from Table 17.
(2) Data qualifiers: J = estimated value. J- = estimated value, biased low.

TABLE 22 - WETLAND AND POND SEDIMENT EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$ [3]	TCEQ Ecological Benchmark for Sediment [4]	EPA EcoTox Threshold [5]			
METALS						
Aluminum	1.5E+05	---	---	1.5E+05	---	1.5E+05
Antimony	8.3E+01	---	---	8.3E+01	---	8.3E+01
Arsenic	1.1E+02	8.2E+00	8.2E+00	8.2E+00	8.7E+00	8.7E+00
Barium	2.3E+04	---	---	2.3E+04	4.6E+02	2.3E+04
Beryllium	2.7E+01	---	---	2.7E+01	---	2.7E+01
Boron	1.1E+05	---	---	1.1E+05	---	1.1E+05
Cadmium	1.1E+03	1.2E+00	1.2E+00	1.2E+00	---	1.2E+00
Chromium	3.6E+04	8.1E+01	8.1E+01	8.1E+01	2.4E+01	8.1E+01
Chromium (VI)	1.4E+02	---	---	1.4E+02	---	1.4E+02
Cobalt	3.2E+04	---	---	3.2E+04	---	3.2E+04
Copper	2.1E+04	3.4E+01	3.4E+01	3.4E+01	2.4E+01	3.4E+01
Iron	---	---	---	NV	---	NV
Lead	5.0E+02	4.7E+01	4.7E+01	4.7E+01	1.8E+01	4.7E+01
Lithium	1.1E+04	---	---	1.1E+04	3.6E+01	1.1E+04
Manganese	1.4E+04	---	---	1.4E+04	6.5E+02	1.4E+04
Mercury	3.4E+01	1.5E-01	1.5E-01	1.5E-01	3.5E-02	1.5E-01
Molybdenum	1.8E+03	---	---	1.8E+03	7.4E-01	1.8E+03
Nickel	1.4E+03	2.1E+01	2.1E+01	2.1E+01	---	2.1E+01
Selenium	2.7E+03	---	---	2.7E+03	---	2.7E+03
Silver	3.5E+02	1.0E+00	1.0E+00	1.0E+00	---	1.0E+00
Strontium	1.5E+05	---	---	1.5E+05	---	1.5E+05
Thallium	4.3E+01	---	---	4.3E+01	---	4.3E+01
Tin	9.2E+04	---	---	9.2E+04	---	9.2E+04
Titanium	1.0E+06	---	---	1.0E+06	---	1.0E+06
Vanadium	3.3E+02	---	---	3.3E+02	---	3.3E+02
Zinc	7.6E+04	1.5E+02	1.5E+02	1.5E+02	2.8E+02	2.8E+02
PESTICIDES						
4,4'-DDD	1.2E+02	1.2E-03	1.2E-03	1.2E-03	---	1.2E-03
4,4'-DDE	8.7E+01	2.1E-03	2.1E-03	2.1E-03	---	2.1E-03
4,4'-DDT	8.7E+01	1.2E-03	1.2E-03	1.2E-03	---	1.2E-03

TABLE 22 - WETLAND AND POND SEDIMENT EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$[3]	TCEQ Ecological Benchmark for Sediment[4]	EPA EcoTox Threshold[5]			
Aldrin	8.4E-01	---	---	8.4E-01	---	8.4E-01
alpha-BHC	4.1E+00	---	---	4.1E+00	---	4.1E+00
alpha-Chlordane	4.1E+01	2.3-03[7]	---	2.3E-03	---	2.3E-03
beta-BHC	1.4E+01	---	---	1.4E+01	---	1.4E+01
delta-BHC	1.4E+01	---	---	1.4E+01	---	1.4E+01
Dieldrin	8.9E-01	7.2E-04	7.2E-04	7.2E-04	---	7.2E-04
Endosulfan I	3.1E+02	---	2.9E-03	2.9E-03	---	2.9E-03
Endosulfan II	9.2E+02	---	1.4E-02	1.4E-02	---	1.4E-02
Endosulfan sulfate	9.2E+02	---	---	9.2E+02	---	9.2E+02
Endrin	4.6E+01	---	3.5E-03	3.5E-03	---	3.5E-03
Endrin aldehyde	4.6E+01	---	---	4.6E+01	---	4.6E+01
Endrin ketone	4.6E+01	---	---	4.6E+01	---	4.6E+01
gamma-BHC (Lindane)	2.0E+01	3.2E-04	3.2E-04	3.2E-04	---	3.2E-04
gamma-Chlordane	4.1E+01	2.3-03[7]	---	2.3E-03	---	2.3E-03
Heptachlor	3.2E+00	---	---	3.2E+00	---	3.2E+00
Heptachlor epoxide	1.6E+00	---	---	1.6E+00	---	1.6E+00
Methoxychlor	7.7E+02	---	1.9E-02	1.9E-02	---	1.9E-02
Toxaphene	1.3E+01	---	2.8E-02	2.8E-02	---	2.8E-02
PCBs	2.3E+00	2.3E-02		2.3E-02	---	2.3E-02
Aroclor-1016	---	---	---	0.0E+00	---	0.0E+00
Aroclor-1221	---	---	---	0.0E+00	---	0.0E+00
Aroclor-1232	---	---	---	0.0E+00	---	0.0E+00
Aroclor-1242	---	---	---	0.0E+00	---	0.0E+00
Aroclor-1248	---	---	---	0.0E+00	---	0.0E+00
Aroclor-1254	---	---	---	0.0E+00	---	0.0E+00
Aroclor-1260	---	---	---	0.0E+00	---	0.0E+00
VOCs						
1,1,1,2-Tetrachloroethane	2.1E+03	---	---	2.1E+03	---	2.1E+03
1,1,1-Trichloroethane	1.5E+05	2.6E+00	1.7E-01	1.7E-01	---	1.7E-01
1,1,2,2-Tetrachloroethane	2.7E+02	6.1E-01	9.4E-01	6.1E-01	---	6.1E-01
1,1,2-Trichloroethane	9.6E+02	3.0E-01	---	3.0E-01	---	3.0E-01

TABLE 22 - WETLAND AND POND SEDIMENT EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$ [3]	TCEQ Ecological Benchmark for Sediment [4]	EPA EcoTox Threshold [5]			
1,1-Dichloroethane	7.3E+04	---	---	7.3E+04	---	7.3E+04
1,1-Dichloroethene	3.7E+04	1.5E+01	---	1.5E+01	---	1.5E+01
1,1-Dichloropropene	5.4E+02	---	---	5.4E+02	---	5.4E+02
1,2,3-Trichloropropane	7.8E+00	---	---	7.8E+00	---	7.8E+00
1,2,4-Trichlorobenzene	1.5E+03	3.9E-01	9.2E+00	3.9E-01	---	3.9E-01
1,2,4-Trimethylbenzene	3.7E+04	2.2E+00	---	2.2E+00	---	2.2E+00
1,2-Dibromo-3-chloropropane	1.0E+01	---	---	1.0E+01	---	1.0E+01
1,2-Dibromoethane	2.7E+01	---	---	2.7E+01	---	2.7E+01
1,2-Dichlorobenzene	6.6E+04	7.4E-01	3.4E-01	3.4E-01	---	3.4E-01
1,2-Dichloroethane	6.0E+02	4.3E+00	---	4.3E+00	---	4.3E+00
1,2-Dichloropropane	8.0E+02	2.8E+00	---	2.8E+00	---	2.8E+00
1,3,5-Trimethylbenzene	3.7E+04	---	---	3.7E+04	---	3.7E+04
1,3-Dichlorobenzene	2.2E+04	3.2E-01	1.7E+00	3.2E-01	---	3.2E-01
1,3-Dichloropropane	5.4E+02	4.0E-02	---	4.0E-02	---	4.0E-02
1,4-Dichlorobenzene	2.3E+03	7.0E-01	3.5E-01	3.5E-01	---	3.5E-01
2,2-Dichloropropane	8.0E+02	---	---	8.0E+02	---	8.0E+02
2-Butanone	4.4E+05	---	---	4.4E+05	---	4.4E+05
2-Chloroethylvinyl ether	5.0E+01	---	---	5.0E+01	---	5.0E+01
2-Chlorotoluene	3.1E+03	---	---	3.1E+03	---	3.1E+03
2-Hexanone	4.4E+04	---	---	4.4E+04	---	4.4E+04
4-Chlorotoluene	1.5E+04	---	---	1.5E+04	---	1.5E+04
4-Isopropyltoluene	7.3E+04	---	---	7.3E+04	---	7.3E+04
4-Methyl-2-pentanone	5.9E+04	4.5E+01	---	4.5E+01	---	4.5E+01
Acetone	6.6E+05	1.7E+02	---	1.7E+02	---	1.7E+02
Acrolein	3.7E+02	---	---	3.7E+02	---	3.7E+02
Acrylonitrile	1.0E+02	1.7E-01	---	1.7E-01	---	1.7E-01
Benzene	9.9E+02	1.4E-01	5.7E-02	5.7E-02	---	5.7E-02
Bromobenzene	1.5E+04	---	---	1.5E+04	---	1.5E+04
Bromodichloromethane	8.8E+02	---	---	8.8E+02	---	8.8E+02
Bromoform	6.9E+03	1.8E+00	6.5E-01	6.5E-01	---	6.5E-01
Bromomethane	1.0E+03	---	---	1.0E+03	---	1.0E+03

TABLE 22 - WETLAND AND POND SEDIMENT EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$[3]	TCEQ Ecological Benchmark for Sediment[4]	EPA EcoTox Threshold[5]			
Butanol	7.3E+04	---	---	7.3E+04	---	7.3E+04
Carbon disulfide	7.3E+04	---	---	7.3E+04	---	7.3E+04
Carbon tetrachloride	4.2E+02	3.7E+00	1.2E+00	1.2E+00	---	1.2E+00
Chlorobenzene	1.5E+04	2.9E-01	8.2E-01	2.9E-01	---	2.9E-01
Chloroethane	2.9E+05	---	---	2.9E+05	---	2.9E+05
Chloroform	7.3E+03	4.3E+00	---	4.3E+00	---	4.3E+00
Chloromethane	4.2E+03	8.7E+00	---	8.7E+00	---	8.7E+00
cis-1,2-Dichloroethene	7.3E+03	---	---	7.3E+03	---	7.3E+03
cis-1,3-Dichloropropene	7.3E+01	---	---	7.3E+01	---	7.3E+01
Cyclohexane	1.0E+06	---	---	1.0E+06		1.0E+06
Dibromochloromethane	6.5E+02	---	---	6.5E+02	---	6.5E+02
Dibromomethane	7.3E+03	---	---	7.3E+03	---	7.3E+03
Dichlorodifluoromethane	1.5E+05	---	---	1.5E+05	---	1.5E+05
Ethylbenzene	7.3E+04	6.5E-01	3.6E+00	6.5E-01	---	6.5E-01
Hexachlorobutadiene	3.1E+01	2.0E-02	---	2.0E-02	---	2.0E-02
Isopropylbenzene (Cumene)	7.3E+04	---	---	7.3E+04	---	7.3E+04
Methyl acetate	7.3E+05	---	---	7.3E+05	---	7.3E+05
Methyl iodide	1.0E+03	---	---	1.0E+03	---	1.0E+03
Methylcyclohexane	1.0E+06	---	---	1.0E+06	---	1.0E+06
Methylene chloride	7.3E+03	3.8E+00	---	3.8E+00	---	3.8E+00
Naphthalene	2.5E+03	1.6E-01	1.6E-01	1.6E-01	---	1.6E-01
n-Butylbenzene	6.1E+03	---	---	6.1E+03	---	6.1E+03
n-Propylbenzene	2.9E+04	---	---	2.9E+04	---	2.9E+04
o-Xylene	1.0E+06	---	---	1.0E+06	---	1.0E+06
sec-Butylbenzene	2.9E+04	---	---	2.9E+04	---	2.9E+04
Styrene	1.5E+05	3.7E+00	---	3.7E+00	---	3.7E+00
tert-Butyl methyl ether (MTBE)	7.3E+03	---	---	7.3E+03	---	7.3E+03
tert-Butylbenzene	2.9E+04	---	---	2.9E+04	---	2.9E+04
Tetrachloroethene	1.0E+03	3.1E+00	5.3E-01	5.3E-01	---	5.3E-01
Toluene	5.9E+04	9.4E-01	6.7E-01	6.7E-01	---	6.7E-01
trans-1,2-Dichloroethene	1.5E+04	---	---	1.5E+04	---	1.5E+04

TABLE 22 - WETLAND AND POND SEDIMENT EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$[3]	TCEQ Ecological Benchmark for Sediment[4]	EPA EcoTox Threshold[5]			
trans-1,3-Dichloropropene	5.4E+02	---	---	5.4E+02	---	5.4E+02
Trichloroethene	4.4E+03	1.5E+00	1.6E+00	1.5E+00	---	1.5E+00
Trichlorofluoromethane	2.2E+05	---	---	2.2E+05	---	2.2E+05
Trichlorotrifluoroethane	1.0E+06	---	---	1.0E+06	---	1.0E+06
Vinyl acetate	7.3E+05	---	---	7.3E+05	---	7.3E+05
Vinyl chloride	3.6E+01	---	---	3.6E+01	---	3.6E+01
Xylene (total)	1.5E+05	2.5E+00	---	2.5E+00	---	2.5E+00
SVOCs						
1,2Diphenylhydrazine/Azobenzen	1.3E+02	---	---	1.3E+02	---	1.3E+02
2,4,5-Trichlorophenol	1.5E+04	---	---	1.5E+04	---	1.5E+04
2,4,6-Trichlorophenol	1.3E+03	---	---	1.3E+03	---	1.3E+03
2,4-Dichlorophenol	4.6E+02	---	---	4.6E+02	---	4.6E+02
2,4-Dimethylphenol	3.1E+03	---	---	3.1E+03	---	3.1E+03
2,4-Dinitrophenol	3.1E+02	---	---	3.1E+02	---	3.1E+02
2,4-Dinitrotoluene	2.1E+01	---	---	2.1E+01	---	2.1E+01
2,6-Dinitrotoluene	2.1E+01	---	---	2.1E+01	---	2.1E+01
2-Chloronaphthalene	9.9E+03	---	---	9.9E+03	---	9.9E+03
2-Chlorophenol	3.7E+03	---	---	3.7E+03	---	3.7E+03
2-Methylnaphthalene	4.9E+02	7.0E-02	7.0E-02	7.0E-02	---	7.0E-02
2-Nitroaniline	4.6E+01	---	---	4.6E+01	---	4.6E+01
2-Nitrophenol	3.1E+02	---	---	3.1E+02	---	3.1E+02
3,3'-Dichlorobenzidine	3.2E+01	---	---	3.2E+01	---	3.2E+01
3-Nitroaniline	4.6E+01	---	---	4.6E+01	---	4.6E+01
4,6-Dinitro-2-methylphenol	3.1E+02	---	---	3.1E+02	---	3.1E+02
4-Bromophenyl phenyl ether	9.5E-01	---	1.3E+00	9.5E-01	---	9.5E-01
4-Chloro-3-methylphenol	7.7E+02	---	---	7.7E+02	---	7.7E+02
4-Chloroaniline	6.1E+02	---	---	6.1E+02	---	6.1E+02
4-Chlorophenyl phenyl ether	9.5E-01	---	---	9.5E-01	---	9.5E-01
4-Nitroaniline	3.7E+02	---	---	3.7E+02	---	3.7E+02
4-Nitrophenol	3.1E+02	---	---	3.1E+02	---	3.1E+02
Acenaphthene	7.4E+03	1.6E-02	1.6E-02	1.6E-02	---	1.6E-02

TABLE 22 - WETLAND AND POND SEDIMENT EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$ [3]	TCEQ Ecological Benchmark for Sediment [4]	EPA EcoTox Threshold [5]			
Acenaphthylene	7.4E+03	4.4E-02	4.4E-02	4.4E-02	---	4.4E-02
Acetophenone	1.5E+04	---	---	1.5E+04	---	1.5E+04
Aniline	1.1E+03	---	---	1.1E+03	---	1.1E+03
Anthracene	3.7E+04	8.5E-02	8.5E-02	8.5E-02	---	8.5E-02
Atrazine (Aatrex)	6.4E+01	---	---	6.4E+01	---	6.4E+01
Benzaldehyde	7.3E+04	---	---	7.3E+04	---	7.3E+04
Benzidine	6.2E-02	---	---	6.2E-02	---	6.2E-02
Benzo(a)anthracene	1.6E+01	2.6E-01	2.6E-01	2.6E-01	---	2.6E-01
Benzo(a)pyrene	1.6E+00	4.3E-01	4.3E-01	4.3E-01	---	4.3E-01
Benzo(b)fluoranthene	1.6E+01	---	---	1.6E+01	---	1.6E+01
Benzo(g,h,i)perylene	3.7E+03	---	---	3.7E+03	---	3.7E+03
Benzo(k)fluoranthene	1.6E+02	---	---	1.6E+02	---	1.6E+02
Benzoic acid	6.1E+05	---	---	6.1E+05	---	6.1E+05
Benzyl alcohol	4.6E+04	---	---	4.6E+04	---	4.6E+04
Biphenyl	7.7E+03	---	1.1E+00	1.1E+00	---	1.1E+00
Bis(2-Chloroethoxy)methane	1.3E+01	---	---	1.3E+01	---	1.3E+01
Bis(2-Chloroethyl)ether	5.0E+01	---	---	5.0E+01	---	5.0E+01
Bis(2-Chloroisopropyl)ether	2.0E+02	---	---	2.0E+02	---	2.0E+02
Bis(2-Ethylhexyl)phthalate	2.4E+02	1.8E-01	1.8E-01	1.8E-01	---	1.8E-01
Butyl benzyl phthalate	3.1E+04	---	1.1E+01	1.1E+01	---	1.1E+01
Caprolactam	7.7E+04	---	---	7.7E+04	---	7.7E+04
Carbazole	7.1E+02	---	---	7.1E+02	---	7.1E+02
Chrysene	1.6E+03	3.8E-01	3.8E-01	3.8E-01	---	3.8E-01
Dibenz(a,h)anthracene	1.6E+00	6.3E-02	6.3E-02	6.3E-02	---	6.3E-02
Dibenzofuran	6.1E+02	---	2.0E+00	2.0E+00	---	2.0E+00
Diethyl phthalate	1.2E+05	---	6.3E-01	6.3E-01	---	6.3E-01
Dimethyl phthalate	1.2E+05	---	---	1.2E+05	---	1.2E+05
Di-n-butyl phthalate	1.5E+04	---	1.1E+01	1.1E+01	---	1.1E+01
Di-n-octyl phthalate	3.1E+03	---	---	3.1E+03	---	3.1E+03
Fluoranthene	4.9E+03	6.0E-01	6.0E-01	6.0E-01	---	6.0E-01
Fluorene	4.9E+03	1.9E-02	1.9E-02	1.9E-02	---	1.9E-02

TABLE 22 - WETLAND AND POND SEDIMENT EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 21 of RI/FS Work Plan[2]			PSV	Potential Site-Specific Background Values[6]	Extent Evaluation Comparison Value
	$^{Tot}Sed_{Comb}$ [3]	TCEQ Ecological Benchmark for Sediment [4]	EPA EcoTox Threshold [5]			
Hexachlorobenzene	8.9E+00	---	---	8.9E+00	---	8.9E+00
Hexachlorocyclopentadiene	9.2E+02	---	---	9.2E+02	---	9.2E+02
Hexachloroethane	1.5E+02	---	1.0E+00	1.0E+00	---	1.0E+00
Indeno(1,2,3-cd)pyrene	1.6E+01	---	---	1.6E+01	---	1.6E+01
Isophorone -	1.5E+04	---	---	1.5E+04	---	1.5E+04
Nitrobenzene	7.7E+01	---	---	7.7E+01	---	7.7E+01
n-Nitrosodimethylamine	1.1E+00	---	---	1.1E+00	---	1.1E+00
n-Nitrosodi-n-propylamine	6.3E-01	---	---	6.3E-01	---	6.3E-01
n-Nitrosodiphenylamine	9.0E+02	---	---	9.0E+02	---	9.0E+02
o-Cresol	7.7E+03	---	---	7.7E+03	---	7.7E+03
Pentachlorophenol	5.6E+01	---	---	5.6E+01	---	5.6E+01
Phenanthrene	3.7E+03	2.4E-01	2.4E-01	2.4E-01	---	2.4E-01
Phenol	4.6E+04	---	---	4.6E+04	---	4.6E+04
Pyrene	3.7E+03	6.7E-01	6.7E-01	6.7E-01	---	6.7E-01
Pyridine	7.3E+02	---	---	7.3E+02	---	7.3E+02
Chloride	---	---	---	NV	NV	NV
Sulfate	---	---	---	NV	NV	NV
Total Moisture	---	---	---	NV	NV	NV
Total Organic Carbon	---	---	---	NV	NV	NV

Notes

1. All values in mg/kg.
2. Values from Table 21 of RI/FS Work Plan (updated to reflect changes since 2005 where applicable).
3. $^{Tot}Sed_{Comb}$ PCL = TCEQ Protective Concentration Level for total sediment combined pathway (includes inhalation; ingestion; dermal pathways).
4. From Table 3-3 of TCEQ "Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas".
5. From Table 2 of EPA "Ecotox Thresholds" ECO Update January 1996.
6. 95% UTL calculated from site-specific background samples.
7. Value listed is for total Chlordane.
8. NV = No Preliminary Screening Value.

TABLE 23 - DETECTED RI WETLAND SEDIMENT SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
NA1SE01	0-0.5	4,4'-DDT	0.00204J[2]	0.00119
NA2SE02	0-0.5	4,4'-DDT	0.00194J	0.00119
NA3SE03	0-0.5	4,4'-DDT	0.0016J	0.00119
NA4SE04	0-0.5	4,4'-DDT	0.00454J	0.00119
NB1SE05	0-0.5	Nickel	23.1	20.9
NB2SE06	1-2	2-Methylnaphthalene	0.43	0.07
		Acenaphthene	0.037J	0.016
		Fluorene	0.088	0.019
NB3SE07	0-0.5	4,4'-DDT	0.00186J	0.00119
NB4SE08	0-0.5	4,4'-DDT	0.00922J+	0.00119
		Acenaphthene	0.113	0.016
		Anthracene	0.188	0.0853
		Benzo(a)anthracene	0.993	0.261
		Benzo(a)pyrene	1.3J	0.43
		Chrysene	1.27	0.384
		Copper	39.6	34
		Dibenz(a,h)anthracene	0.337J-	0.0634
		Fluoranthene	2.17	0.6
		Fluorene	0.127	0.019
		Lead	88.1	46.7
		Phenanthrene	1.3	0.24
		Pyrene	1.64J-	0.665
		Zinc	601	280
NC3SE11	0-0.5	4,4'-DDT	0.00143J	0.00119
NC4SE12	0-0.5	4,4'-DDT	0.00468J+	0.00119

TABLE 23 - DETECTED RI WETLAND SEDIMENT SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
NF4SE13	0-0.5	4,4'-DDT	0.00254J+	0.00119
		Arsenic	12.8	8.66
		Copper	35.7	34
		Lead	64.7	46.7
		Nickel	27.7	20.9
		Zinc	903	280
NG1SE14	0-0.5	Nickel	23.8	20.9
NG2SE15	0-0.5	4,4'-DDT	0.00189J	0.00119
NG4SE17	0-0.5	Dieldrin	0.00266	0.000715
		Zinc	255	280
2WSED3	0-0.5	Acenaphthylene	0.346J	0.044
		Anthracene	0.241J	0.0853
		Benzo(a)pyrene	0.631J	0.43
		Chrysene	2.73	0.384
		Dibenz(a,h)anthracene	2.83	0.0634
		Pyrene	0.729J	0.665
2WSED4	0-0.5	4,4'-DDE	0.00256J	0.00207
		Acenaphthylene	0.545J	0.044
		Anthracene	0.334J	0.0853
		Benzo(a)pyrene	0.972	0.43
		Chrysene	4.05	0.384
		Dibenz(a,h)anthracene	2.91	0.0634
		Dieldrin	0.00211J	0.000715
		Nickel	21.3	20.9
		Pyrene	1.18	0.665
2WSED5	0-0.5	Acenaphthylene	0.139J	0.044
		Dibenz(a,h)anthracene	1.83	0.0634

TABLE 23 - DETECTED RI WETLAND SEDIMENT SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
2WSED9	0-0.5	4,4'-DDT	0.00206J	0.00119
		Dibenz(a,h)anthracene	0.129	0.0634
2WSED10	0-0.5	4,4'-DDT	0.0015J	0.00119
2WSED12	0-0.5	4,4'-DDT	0.00212J	0.00119
2WSED15	0-0.5	Chrysene	0.39J	0.384
		Copper	49	34
		Lead	50	46.7
		Zinc	539	280
2WSED17	0-0.5	Acenaphthene	0.133	0.016
		Anthracene	0.257	0.0853
		Benzo(a)anthracene	0.724	0.261
		Benzo(a)pyrene	0.618	0.43
		Chrysene	0.743	0.384
		Dibenz(a,h)anthracene	0.312	0.0634
		Fluoranthene	1.43	0.6
		Fluorene	0.139	0.019
		Lead	237	46.7
		Phenanthrene	1.18	0.24
		Pyrene	1.34	0.665
		Zinc	404	280
3WSED9	0-0.5	Zinc	319 J	280

Notes:

(1) Extent Evaluation Comparison Values from Table 22.

(2) Data Qualifiers: J = estimated value; J- = estimated value, biased low; J+ = estimated value, biased high.

TABLE 24 - DETECTED RI WETLAND SURFACE WATER SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Chemical of Interest	Total or Dissolved	Concentration (mg/L)	Extent Evaluation Comparison Value[1] (mg/L)
2WSW1	Acrolein	Total	0.00929J[2]	0.005
	Copper	Dissolved	0.011J	0.0036
	Mercury	Total	0.00004J	0.000025
2WSW2	Copper	Dissolved	0.0053J	0.0036
	Mercury	Dissolved	0.00011J	0.000025
		Total	0.00007J	0.000025
2WSW6	Copper	Dissolved	0.0068J	0.0036
	Manganese	Total	0.34	0.1
		Dissolved	0.33	0.1

Notes:
(1) Extent Evaluation Comparision Values from Table 14.
(2) Data Qualifier: J = estimated value.

TABLE 25 - DETECTED RI POND SEDIMENT SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Chemical of Interest	Concentration (mg/kg)	Extent Evaluation Comparison Value[1] (mg/kg)
SPSE01	Zinc	614	280
SPSE02	Zinc	813	280
SPSE03	4,4'-DDT	0.00157J[2]	0.00119
	Zinc	999	280

Notes:
(1) Extent Evaluation Comparison Values from Table 22.
(2) Data Qualifier: J = estimated value.

TABLE 26 - DETECTED RI POND SURFACE WATER SAMPLE CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Chemical of Interest	Total or Dissolved	Concentration (mg/L)	Extent Evaluation Comparison Value[(1)] (mg/L)
FWPSW01	Arsenic	Total	0.013J[(2)]	0.0014
	Silver	Dissolved	0.0027J	0.00019
	Thallium	Total	0.0077J	0.00047
FWPSW02	Arsenic	Total	0.012J	0.0014
	Silver	Dissolved	0.0021J	0.00019
FWPSW03	Silver	Dissolved	0.0029J	0.00019
	Thallium	Total	0.0062J	0.00047
SPSW01	Manganese	Total	1.29	0.1
	Manganese	Dissolved	1.06	0.1
	Silver	Dissolved	0.00095J	0.00019
	Thallium	Dissolved	0.0014J	0.00047
SPSW02	Manganese	Total	1.44	0.1
	Manganese	Dissolved	0.89	0.1
	Silver	Dissolved	0.00094J	0.00019
	Thallium	Dissolved	0.0032J	0.00047
SPSW03	Manganese	Total	0.82	0.1
	Manganese	Dissolved	0.74	0.1
	Silver	Dissolved	0.0014J	0.00019
	Thallium	Dissolved	0.0019J	0.00047

Notes:
(1) Extent Evaluation Comparison Values from Table 14.
(2) Data Qualifier: J = estimated value.

TABLE 27 - DETECTED CONCENTRATIONS IN SBMW29-01 AND SBMW30-01 SOIL SAMPLES

Sample Location	Sample Depth (ft)	Chemical of Interest	Concentration (mg/kg)
SBMW29-01	12.5-13.5	1,1,1-Trichloroethane	3750
		1,1-Dichloroethane	67.3J[1]
		1,1-Dichloroethene	128J
		1,2,3-Trichloropropane	471
		1,2-Dichloroethane	595
		Benzene	84.3J
		Benzo(b)fluoranthene	0.017J
		Fluoranthene	0.03J
		Fluorene	0.013J
		Isopropylbenzene (Cumene)	93.7J
		Methylene chloride	1130
		Naphthalene	102J
		Phenanthrene	0.057J
		Tetrachloroethene	4340
		Toluene	108J
		Trichloroethene	2150
SBMW30-01	33.6-34.1	1,1,1-Trichloroethane	4590
		1,2,3-Trichloropropane	1220
		2-Methylnaphthalene	52.8
		Acenaphthene	18.9J
		Acenaphthylene	11.5
		Aldrin	0.037
		Anthracene	18
		Benzo(a)anthracene	31.9
		Benzo(a)pyrene	18.4
		Benzo(b)fluoranthene	37.7
		Benzo(g,h,i)perylene	20.4
		Biphenyl	12.1J
		Carbazole	15.2
		Chrysene	36.8
		Dibenz(a,h)anthracene	8.93
		Dibenzofuran	29.9
		Endosulfan II	0.025J
		Endrin aldehyde	0.049J
		Fluoranthene	86.1
		Fluorene	44.1
		gamma-BHC (Lindane)	0.00796J
		Heptachlor epoxide	0.167J
		Indeno(1,2,3-cd)pyrene	19.5
		Naphthalene	317J
		Phenanthrene	172
		Pyrene	80
		Tetrachloroethene	8420
		Toluene	170J
		Trichloroethene	6610

Notes:
(1) Data qualifier: J = estimated value.

TABLE 28 - GROUNDWATER EXTENT EVALUATION COMPARISON VALUES[1]

	Potential Preliminary Screening Values (PSVs) from Table 18 of RI/FS Work Plan[2]			
Chemicals of Interest	$^{GW}GW_{Class\ 3}$[3]	$^{Air}GW_{Inh\text{-}V}$[4]	TCEQ Ecological Benchmark for Water[5]	Extent Evaluation Comparison Value
METALS				
Aluminum	7.3E+03	---	---	7.3E+03
Antimony	6.0E-01	---	---	6.0E-01
Arsenic	1.0E+00	---	7.8E-02	7.8E-02
Barium	2.0E+02	---	2.5E+01	2.5E+01
Beryllium	4.0E-01	---	---	4.0E-01
Boron	1.5E+03	---	---	1.5E+03
Cadmium	5.0E-01	---	1.0E-02	1.0E-02
Chromium	1.0E+01	---	1.0E-01	1.0E-01
Chromium (VI)	1.0E+01	---	5.0E-02	5.0E-02
Cobalt	2.2E+00	---	---	2.2E+00
Copper	1.3E+02	---	3.6E-03	3.6E-03
Ferric Iron	---	---	---	NV
Iron	---	---	---	NV
Lead	1.5E+00	---	5.3E-03	5.3E-03
Lithium	1.5E+01	---	---	1.5E+01
Manganese	1.0E+03	---	---	1.0E+03
Mercury	2.0E-01	1.3E+00	1.1E-03	1.1E-03
Molybdenum	3.7E+01	---	---	3.7E+01
Nickel	1.5E+02	---	1.3E-02	1.3E-02
Selenium	5.0E+00	---	1.4E-01	1.4E-01
Silver	3.7E+01	---	1.9E-04	1.9E-04
Strontium	4.4E+03	---	---	4.4E+03
Thallium	2.0E-01	---	2.1E-02	2.1E-02
Tin	4.4E+03	---	---	4.4E+03
Titanium	3.7E+06	---	---	3.7E+06
Vanadium	5.1E+01	---	---	5.1E+01
Zinc	2.2E+03	---	8.4E-02	8.4E-02
PESTICIDES				
4,4'-DDD	8.5E-01	---	2.5E-05	2.5E-05
4,4'-DDE	6.0E-01	---	1.4E-04	1.4E-04
4,4'-DDT	6.0E-01	1.4E+02	1.0E-06	1.0E-06
Aldrin	1.2E-02	9.6E-01	1.3E-04	1.3E-04
alpha-BHC	3.2E-02	3.3E+01	2.5E-02	2.5E-02
alpha-Chlordane	5.8E-01	3.3E+01	---	5.8E-01
beta-BHC	1.1E-01	2.5E+02	---	1.1E-01
delta-BHC	1.1E-01	7.9E+01	---	1.1E-01
Dieldrin	1.3E-02	2.8E+01	2.0E-06	2.0E-06
Endosulfan I	1.5E+01	1.6E+02	9.0E-06	9.0E-06
Endosulfan II	4.4E+01	---	9.0E-06	9.0E-06
Endosulfan sulfate	4.4E+01	---	9.0E-06	9.0E-06
Endrin	2.0E-01	5.9E+02	2.0E-06	2.0E-06
Endrin aldehyde	2.2E+00	---	---	2.2E+00
Endrin ketone	2.2E+00	5.1E+02	---	2.2E+00
gamma-BHC (Lindane)	2.0E-02	1.5E+03	1.6E-05	1.6E-05
gamma-Chlordane	5.8E-01	3.3E+01	---	5.8E-01
Heptachlor	4.0E-02	1.4E+00	4.0E-06	4.0E-06
Heptachlor epoxide	2.0E-02	2.6E+01	3.6E-06	3.6E-06
Methoxychlor	4.0E+00	6.3E+03	3.0E-05	3.0E-05
Toxaphene	3.0E-01	3.9E+02	2.0E-07	2.0E-07

TABLE 28 - GROUNDWATER EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 18 of RI/FS Work Plan[2] ${}^{GW}GW_{Class\ 3}$ [3]	${}^{Air}GW_{Inh\text{-}V}$ [4]	TCEQ Ecological Benchmark for Water[5]	Extent Evaluation Comparison Value
PCBs	5.0E-02	6.4E-01	3.0E-05	3.0E-05
Aroclor-1016	---	---	---	NV
Aroclor-1221	---	---	---	NV
Aroclor-1232	---	---	---	NV
Aroclor-1242	---	---	---	NV
Aroclor-1248	---	---	---	NV
Aroclor-1254	---	---	---	NV
Aroclor-1260	---	---	---	NV
VOCs				
1,1,1,2-Tetrachloroethane	7.9E+00	2.4E+01	---	7.9E+00
1,1,1-Trichloroethane	2.0E+01	7.2E+03	1.6E+00	1.6E+00
1,1,2,2-Tetrachloroethane	1.0E+00	9.6E+00	4.5E-01	4.5E-01
1,1,2-Trichloroethane	5.0E-01	1.7E+01	2.8E-01	2.8E-01
1,1-Dichloroethane	1.5E+03	1.3E+03	---	1.3E+03
1,1-Dichloroethene	7.0E-01	3.0E+02	1.3E+01	7.0E-01
1,1-Dichloropropene	2.0E+00	4.2E+00	---	2.0E+00
1,2,3-Trichloropropane	2.9E-02	1.2E+03	---	2.9E-02
1,2,4-Trichlorobenzene	7.0E+00	2.8E+03	2.2E-02	2.2E-02
1,2,4-Trimethylbenzene	3.7E+02	3.4E+01	2.2E-01	2.2E-01
1,2-Dibromo-3-chloropropane	2.0E-02	1.3E-01	---	2.0E-02
1,2-Dibromoethane	5.0E-03	1.2E+00	---	5.0E-03
1,2-Dichlorobenzene	6.0E+01	2.1E+02	9.9E-02	9.9E-02
1,2-Dichloroethane	5.0E-01	7.2E+00	5.7E+00	5.0E-01
1,2-Dichloroethene(Total)	---	---	6.8E-01	6.8E-01
1,2-Dichloropropane	5.0E-01	2.1E+01	2.4E+00	5.0E-01
1,3,5-Trimethylbenzene	3.7E+02	2.3E+01	---	2.3E+01
1,3-Dichlorobenzene	2.2E+02	3.4E+01	1.4E-01	1.4E-01
1,3-Dichloropropane	2.0E+00	5.5E+01	---	2.0E+00
1,4-Dichlorobenzene	7.5E+00	6.5E+02	9.9E-02	9.9E-02
2,2-Dichloropropane	3.0E+00	1.0E+01	---	3.0E+00
2-Butanone	4.4E+03	4.9E+05	---	4.4E+03
2-Chloroethylvinyl ether	1.9E-01	3.5E+00	---	1.9E-01
2-Chlorotoluene	1.5E+02	1.4E+03	---	1.5E+02
2-Hexanone	4.4E+02	2.8E+02	---	2.8E+02
4-Chlorotoluene	5.1E+02	1.4E+00	---	1.4E+00
4-Isopropyltoluene	7.3E+02	8.3E+02	---	7.3E+02
4-Methyl-2-pentanone	5.8E+02	1.2E+05	6.2E+01	6.2E+01
Acetone	6.6E+03	4.6E+04	2.8E+02	2.8E+02
Acrolein	3.7E+00	1.3E+01	1.0E-02	1.0E-02
Acrylonitrile	3.8E-01	1.3E+01	2.9E-01	2.9E-01
Benzene	5.0E-01	3.9E+01	1.1E-01	1.1E-01

TABLE 28 - GROUNDWATER EXTENT EVALUATION COMPARISON VALUES[1]

	Potential Preliminary Screening Values (PSVs) from Table 18 of RI/FS Work Plan[2]			
Chemicals of Interest	$^{GW}GW_{Class\ 3}$[3]	$^{Air}GW_{Inh\text{-}V}$[4]	**TCEQ Ecological Benchmark for Water**[5]	**Extent Evaluation Comparison Value**
Bromobenzene	1.5E+02	6.8E+01	---	6.8E+01
Bromodichloromethane	3.3E+00	---	---	3.3E+00
Bromoform	2.6E+01	1.1E+03	1.2E+00	1.2E+00
Bromomethane	1.0E+01	8.3E+00	1.2E+00	1.2E+00
Butanol	7.3E+02	3.6E+04	---	7.3E+02
Carbon disulfide	7.3E+02	8.8E+02	---	7.3E+02
Carbon tetrachloride	5.0E-01	1.7E+00	1.5E+00	5.0E-01
Chlorobenzene	1.0E+01	2.1E+02	1.1E-01	1.1E-01
Chloroethane	2.9E+03	2.1E+04	---	2.9E+03
Chloroform	7.3E+01	4.3E+00	4.1E+00	4.1E+00
Chloromethane	1.6E+01	7.9E+00	1.4E+01	7.9E+00
cis-1,2-Dichloroethene	7.0E+00	2.9E+03	---	7.0E+00
cis-1,3-Dichloropropene	3.8E-01	4.2E+01	---	3.8E-01
Cyclohexane	3.7E+04	1.1E+03	---	1.1E+03
Dibromochloromethane	2.4E+00	---	---	2.4E+00
Dibromomethane	2.7E+01	1.4E+02	---	2.7E+01
Dichlorodifluoromethane	1.5E+03	1.3E+02	---	1.3E+02
Ethylbenzene	7.0E+01	2.8E+03	2.5E-01	2.5E-01
Hexachlorobutadiene	2.6E+00	1.9E+00	3.2E-04	3.2E-04
Isopropylbenzene (Cumene)	7.3E+02	8.0E+02	---	7.3E+02
Methyl acetate	7.3E+03	2.4E+04	---	7.3E+03
Methyl iodide	1.0E+01	3.1E+01	---	1.0E+01
Methylcyclohexane	3.7E+04	2.6E+02	---	2.6E+02
Methylene chloride	5.0E-01	2.8E+02	5.4E+00	5.0E-01
Naphthalene	1.5E+02	5.7E+01	1.3E-01	1.3E-01
n-Butylbenzene	2.9E+02	6.6E+02	---	2.9E+02
n-Propylbenzene	2.9E+02	1.1E+03	---	2.9E+02
o-Xylene	1.0E+03	2.2E+04	---	1.0E+03
sec-Butylbenzene	2.9E+02	7.0E+02	---	2.9E+02
Styrene	1.0E+01	2.7E+03	4.6E-01	4.6E-01
tert-Butyl methyl ether (MTBE)	7.3E+01	8.8E+02	---	7.3E+01
tert-Butylbenzene	2.9E+02	4.5E+02	---	2.9E+02
Tetrachloroethene	5.0E-01	1.1E+02	1.5E+00	5.0E-01
Toluene	1.0E+02	1.2E+04	4.8E-01	4.8E-01
trans-1,2-Dichloroethene	1.0E+01	1.4E+02	---	1.0E+01
trans-1,3-Dichloropropene	2.0E+00	4.1E+01	---	2.0E+00
trans-1,4-Dichloro-2-butene	---	2.3E-01	---	2.3E-01
Trichloroethene	5.0E-01	2.1E+01	9.7E-01	5.0E-01
Trichlorofluoromethane	2.2E+03	7.4E+02	---	7.4E+02
Trichlorotrifluoroethane	2.2E+05	1.7E+03	---	1.7E+03
Vinyl acetate	7.3E+03	2.6E+03	---	2.6E+03
Vinyl chloride	2.0E-01	8.3E-01	---	2.0E-01
Xylene (total)	1.0E+03	1.9E+03	8.5E-01	8.5E-01

TABLE 28 - GROUNDWATER EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 18 of RI/FS Work Plan[2]			Extent Evaluation Comparison Value
	$^{GW}GW_{Class\ 3}$[3]	$^{Air}GW_{Inh\text{-}V}$[4]	TCEQ Ecological Benchmark for Water[5]	
SVOCs				
1,2Diphenylhydrazine/Azobenzen	1.9E+00	1.5E+02	---	1.9E+00
2,4,5-Trichlorophenol	7.3E+02	8.2E+04	1.2E-02	1.2E-02
2,4,6-Trichlorophenol	7.3E+00	1.1E+04	6.1E-02	6.1E-02
2,4-Dichlorophenol	2.2E+01	9.8E+04	---	2.2E+01
2,4-Dimethylphenol	1.5E+02	3.0E+04	---	1.5E+02
2,4-Dinitrophenol	1.5E+01	---	1.3E+00	1.3E+00
2,4-Dinitrotoluene	3.0E-01	2.2E+02	---	3.0E-01
2,6-Dinitrotoluene	3.0E-01	5.7E+02	---	3.0E-01
2-Chloronaphthalene	5.8E+02	---	---	5.8E+02
2-Chlorophenol	3.7E+01	1.1E+04	2.7E-01	2.7E-01
2-Methylnaphthalene	2.9E+01	---	3.0E-02	3.0E-02
2-Nitroaniline	2.2E+00	7.2E+02	---	2.2E+00
2-Nitrophenol	1.5E+01	1.2E+04	1.5E+00	1.5E+00
3,3'-Dichlorobenzidine	4.5E-01	---	3.7E-02	3.7E-02
3-Nitroaniline	2.2E+00	1.3E+04	---	2.2E+00
4,6-Dinitro-2-methylphenol	7.3E-01	1.5E+03	---	7.3E-01
4-Bromophenyl phenyl ether	1.4E-02	3.4E-01	---	1.4E-02
4-Chloro-3-methylphenol	3.7E+01	1.1E+05	---	3.7E+01
4-Chloroaniline	1.0E+00	1.2E+04	---	1.0E+00
4-Chlorophenyl phenyl ether	1.4E-02	2.7E-01	---	1.4E-02
4-Nitroaniline	1.0E+01	2.6E+04	---	1.0E+01
4-Nitrophenol	1.5E+01	4.3E+03	3.6E-01	3.6E-01
Acenaphthene	4.4E+02	---	4.0E-02	4.0E-02
Acenaphthylene	4.4E+02	---	---	4.4E+02
Acetophenone	7.3E+02	2.5E+04	---	7.3E+02
Aniline	3.6E+01	2.0E+03	---	3.6E+01
Anthracene	2.2E+03	---	1.8E-04	1.8E-04
Atrazine (Aatrex)	3.0E-01	3.3E+04	---	3.0E-01
Benzaldehyde	7.3E+02	9.4E+02	---	7.3E+02
Benzidine	8.9E-04	1.4E+00	---	8.9E-04
Benzo(a)anthracene	2.8E-01	4.4E+02	---	2.8E-01
Benzo(a)pyrene	2.0E-02	8.4E+01	---	2.0E-02
Benzo(b)fluoranthene	2.8E-01	3.5E+02	---	2.8E-01
Benzo(g,h,i)perylene	2.2E+02	---	---	2.2E+02
Benzo(k)fluoranthene	2.8E+00	2.1E+04	---	2.8E+00
Benzoic acid	2.9E+04	1.9E+04	---	1.9E+04
Benzyl alcohol	3.7E+03	1.7E+05	---	3.7E+03
Biphenyl	3.7E+02	3.7E+01	---	3.7E+01

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TABLE 28 - GROUNDWATER EXTENT EVALUATION COMPARISON VALUES[1]

Chemicals of Interest	Potential Preliminary Screening Values (PSVs) from Table 18 of RI/FS Work Plan[2]			Extent Evaluation Comparison Value
	$^{GW}GW_{Class\ 3}$[3]	$^{Air}GW_{Inh-V}$[4]	TCEQ Ecological Benchmark for Water[5]	
Bis(2-Chloroethoxy)methane	1.9E-01	1.7E+01	---	1.9E-01
Bis(2-Chloroethyl)ether	1.9E-01	2.0E+01	---	1.9E-01
Bis(2-Chloroisopropyl)ether	2.9E+00	1.9E+02	---	2.9E+00
Bis(2-Ethylhexyl)phthalate	6.0E-01	---	---	6.0E-01
Butyl benzyl phthalate	1.1E+02	2.2E+04	1.5E-01	1.5E-01
Caprolactam	3.7E+03	4.4E+03	---	3.7E+03
Carbazole	1.0E+01	---	---	1.0E+01
Chrysene	2.8E+01	1.3E+05	---	2.8E+01
Dibenz(a,h)anthracene	2.8E-02	2.3E+02	---	2.8E-02
Dibenzofuran	2.9E+01	---	6.5E-02	6.5E-02
Diethyl phthalate	5.8E+03	2.5E+04	4.4E-01	4.4E-01
Dimethyl phthalate	5.8E+03	1.9E+04	5.8E-01	5.8E-01
Di-n-butyl phthalate	7.3E+02	1.3E+04	5.0E-03	5.0E-03
Di-n-octyl phthalate	1.5E+02	1.8E+03	---	1.5E+02
Fluoranthene	2.9E+02	---	3.0E-03	3.0E-03
Fluorene	2.9E+02	---	5.0E-02	5.0E-02
Hexachlorobenzene	1.0E-01	1.2E+00	---	1.0E-01
Hexachlorocyclopentadiene	5.0E+00	9.8E-01	7.0E-05	7.0E-05
Hexachloroethane	7.3E+00	3.1E+02	9.4E-03	9.4E-03
Indeno(1,2,3-cd)pyrene	2.8E-01	2.0E+03	---	2.8E-01
Isophorone	2.2E+02	1.9E+04	6.5E-01	6.5E-01
Nitrobenzene	1.5E+01	1.6E+02	6.7E-02	6.7E-02
n-Nitrosodimethylamine	4.0E-03	4.4E+00	1.7E+02	4.0E-03
n-Nitrosodi-n-propylamine	2.9E-02	---	1.2E-01	2.9E-02
n-Nitrosodiphenylamine	4.2E+01	---	1.7E+02	4.2E+01
o-Cresol	3.7E+02	1.8E+04	5.1E-01	5.1E-01
Pentachlorophenol	1.0E-01	2.4E+03	9.6E-03	9.6E-03
Phenanthrene	2.2E+02	---	4.6E-03	4.6E-03
Phenol	2.2E+03	5.0E+04	2.8E+00	2.8E+00
Pyrene	2.2E+02	---	2.4E-04	2.4E-04
Pyridine	7.3E+00	4.0E+01	---	7.3E+00
Sulfate	---	---	---	NV
Chloride	---	---	---	NV
Total Dissolved Solids(TDS)	---	---	---	NV
Total Suspended Solids	---	---	---	NV
Total Organic Carbon	---	---	---	NV
Hardness	---	---	---	NV

Notes:

1. All values in mg/L.
2. Values from Table 18 of RI/FS Work Plan (updated to reflect changes from 2005 where applicable).
3. $^{GW}GW_{CLass3}$ PCL = TCEQ Protective Concentration Level for Class 3 groundwater, commerical/industrial land use. March 2009.
4. $^{Air}GW_{Inh-V}$PCL = TCEQ Protective Concentration Level for inhalation of constituents in groundwater, 30 acre source area, commercial/industrial land use. March 2009.
5. From Table 3-2 (Ecological Benchmarks for Water) of TCEQ "Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas." Metals benchmarks are for dissolved concentrations, except for barium, mercury, selenium, and thallium.
6. NV = No Preliminary Screening Value.

TABLE 29 - DETECTED ZONE A GROUNDWATER CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Sample Date	Chemical of Interest	Concentration (mg/L)	Extent Evaluation Comparison Value[1] (mg/L)
NB4PZ01	8/3/2006	Chromium	0.14J	0.1
		Endosulfan II	0.000021J[2]	0.000009
		Nickel	0.14J	0.013
		Silver	0.0088J	0.00019
NC3PZ02	8/2/2006	Chromium	0.16	0.1
		Silver	0.017J	0.00019
ND1PZ03	8/1-2/2006	Benzene	0.657	0.11
		Endosulfan II	0.0000103J	0.000009
		Silver	0.0099J	0.00019
		Vinyl chloride	1.22	0.2
ND2MW01	8/3/2006	1,1,1-Trichloroethane	15.4	1.6
		1,1-Dichloroethene	23.5	0.7
		1,2,3-Trichloropropane	25.5J-	0.029
		1,2-Dichloroethane	58.8	0.5
		1,2-Dichloropropane	3.45J	0.5
		4,4'-DDE	0.00027	0.00014
		Benzene	5.39J	0.11
		Chromium	0.15J	0.1
		cis-1,2-Dichloroethene	13.4	7
		Dieldrin	0.0000264J	0.000002
		gamma-BHC (Lindane)	0.00016J	0.000016
		Methylene chloride	300	0.5
		Silver	0.012J	0.00019
		Tetrachloroethene	20.5	0.5
		Trichloroethene	84	0.5
	11/8/2007	1,1-Dichloroethene	2.92	0.7
		1,2-Dichloroethene(Total)	19.2	0.68
		Benzene	0.518J	0.11
		cis-1,2-Dichloroethene	19.2	7
		Vinyl chloride	0.331J	0.2
	6/18/2008	1,1-Dichloroethene	2.35	0.7
		1,2,3-Trichloropropane	0.374J	0.029
		1,2-Dichloroethane	1.25	0.5
		1,2-Dichloroethene(Total)	12.5	0.68
		Benzene	0.375J	0.11
		cis-1,2-Dichloroethene	12.5	7
		Methylene chloride	2.88	0.5
		Vinyl chloride	0.978J	0.2

TABLE 29 - DETECTED ZONE A GROUNDWATER CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Sample Date	Chemical of Interest	Concentration (mg/L)	Extent Evaluation Comparison Value(1) (mg/L)
ND3MW02	8/3/2006	1,1,1-Trichloroethane	2.25	1.6
		1,2,3-Trichloropropane	0.497J-	0.029
		Anthracene	0.000832J	0.00018
		Chromium	0.15J	0.1
		gamma-BHC (Lindane)	0.00019J	0.000016
		Silver	0.0063J	0.00019
		Tetrachloroethene	1.92	0.5
		Trichloroethene	6.04	0.5
	11/8/2007	1,1,1-Trichloroethane	14	1.6
		1,2,3-Trichloropropane	1.57	0.029
		1,2-Dichloroethene(Total)	9.37	0.68
		Benzene	0.158J	0.11
		cis-1,2-Dichloroethene	9.37	7
		Tetrachloroethene	2.1	0.5
		Trichloroethene	17.7	0.5
	6/18/2008	1,1,1-Trichloroethane	42	1.6
		1,1-Dichloroethene	0.975J	0.7
		1,2,3-Trichloropropane	3.86J	0.029
		1,2-Dichloroethene(Total)	13.6	0.68
		cis-1,2-Dichloroethene	13.6	7
		Tetrachloroethene	34.8	0.5
		Toluene	0.691J	0.48
		Trichloroethene	76	0.5
ND3MW29	6/5/2007	1,1,1-Trichloroethane	156	1.6
		1,2,3-Trichloropropane	44.3J	0.029
		1,2-Dichloroethane	328	0.5
		Endosulfan II	0.00012J	0.000009
		gamma-BHC (Lindane)	0.00153	0.000016
		Methylene chloride	1230	0.5
		Trichloroethene	61.2J	0.5
	11/8/2007	1,1,1-Trichloroethane	195	1.6
		1,1-Dichloroethene	22J	0.7
		1,2,3-Trichloropropane	53.1J	0.029
		1,2-Dichloroethane	292	0.5
		Methylene chloride	1100	0.5
		Trichloroethene	69.4J	0.5
	6/18/2008	1,1,1-Trichloroethane	234	1.6
		1,1-Dichloroethene	21.3J	0.7
		1,2,3-Trichloropropane	44.4J	0.029
		1,2-Dichloroethane	347	0.5
		1,2-Dichloroethene(Total)	24.5J	0.68
		Benzene	5.92J	0.11
		cis-1,2-Dichloroethene	24.5J	7
		Methylene chloride	1100	0.5
		Tetrachloroethene	12.9J	0.5
		Trichloroethene	135	0.5

TABLE 29 - DETECTED ZONE A GROUNDWATER CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Sample Date	Chemical of Interest	Concentration (mg/L)	Extent Evaluation Comparison Value[(1)] (mg/L)
ND3PZ04	7/31/2006	1,1,1-Trichloroethane	62.7	1.6
		1,1-Dichloroethene	29.2	0.7
		1,2,3-Trichloropropane	28.2	0.029
		1,2-Dichloropropane	3.36J	0.5
		Benzene	8.24J	0.11
		Carbon tetrachloride	7.58J	0.5
		cis-1,2-Dichloroethene	124	7
		Heptachlor epoxide	0.000025	0.0000036
		Silver	0.005J	0.00019
		Tetrachloroethene	7.86J	0.5
		Toluene	4.05J	0.48
		Trichloroethene	31.7	0.5
		Vinyl chloride	5.09J	0.2
ND4MW03	8/2/2006	Silver	0.013	0.00019
NE1MW04	8/3/2006	Chromium	0.11J	0.1
		Endosulfan II	0.0000138J	0.000009
		Silver	0.014J	0.00019
NE3MW05	8/2/2006	Anthracene	0.00138J	0.00018
		Ethylbenzene	0.74	0.25
		Naphthalene	0.322	0.13
		Phenanthrene	0.00638	0.0046
		Pyrene	0.000517J	0.00024
		Silver	0.001J	0.00019
	11/7/2007	Ethylbenzene	0.273	0.25
		Naphthalene	0.243	0.13
NF1PZ05	8/3/2006	Chromium	0.13J	0.11
		Endosulfan II	0.0000148J	0.000009
		Silver	0.0085J	0.00019
NF2MW06	8/3/2006	1,2,3-Trichloropropane	0.214	0.029
		Endosulfan sulfate	0.0000156J	0.000009
		Methylene chloride	0.944	0.5
		Silver	0.0032J	0.00019
		Trichloroethene	0.506	0.5
NF3PZ06	8/1/2006	Nickel	0.084	0.013
		Silver	0.011J	0.00019
SA4PZ07	8/3/2006	Chromium	0.14J	0.1
		Endosulfan II	0.0000309J	0.000009
		Nickel	0.022J	0.013
		Silver	0.016J	0.00019
SB4MW07	8/1/2006	Silver	0.03J	0.00019

TABLE 29 - DETECTED ZONE A GROUNDWATER CONCENTRATIONS EXCEEDING EXTENT EVALUATION COMPARISON VALUES

Sample Location	Sample Date	Chemical of Interest	Concentration (mg/L)	Extent Evaluation Comparison Value[1] (mg/L)
SD3PZ08	7/31/2006	Chromium	0.15	0.1
		Silver	0.012J	0.00019
SE1MW08	8/2/2006	Silver	0.011	0.00019
SE6MW09	7/31/2006	Silver	0.0024J	0.00019
SF5MW10	8/1/2006	gamma-BHC (Lindane)	0.000024J	0.000016
	6/4/2007	gamma-BHC (Lindane)	0.000042J	0.000016
SF6MW11	7/31/2006	Silver	0.0099J	0.00019
SF7MW12	7/31/2006	Silver	0.0044J	0.00019
SG2MW13	8/1/2006	Silver	0.015J	0.00019
SH7MW14	7/31/2006	Silver	0.0028J	0.00019
SJ1MW15	8/2/2006	Endosulfan sulfate	0.000104	0.000009
		Heptachlor epoxide	0.0000201J	0.0000036
		Silver	0.0088	0.00019
SJ7MW16	7/31/2006	Silver	0.0048J	0.00019
SL8MW17	8/3/2006	Silver	0.028J	0.00019

Notes:
(1) Extent Evaluation Comparison Values from Table 28.
(2) Data qualifiers: J = estimated value. J- = estimated value, biased low.

TABLE 30 - ZONE B GROUNDWATER CONCENTRATIONS

Sample Location	Sample Date	Chemical of Interest	Concentration (mg/L)	Extent Evaluation Comparison Value (mg/L)[1]
ND4MW24B	6/5/2007	1,1,1-Trichloroethane	<0.000155	1.6
		1,1-Dichloroethene	<0.000226	0.7
		1,2,3-Trichloropropane	<0.000151	0.029
		1,2-Dichloroethane	0.00157J[(2)]	0.5
		1,2-Dichloropropane	<0.0001	0.5
		4,4'-DDE	<0.00000195	0.6
		Anthracene	<0.000102	2,200
		Benzene	<0.000184	0.5
		Carbon tetrachloride	<0.000124	0.5
		cis-1,2-Dichloroethene	0.00431J	7
		Dieldrin	<0.00000425	0.013
		Endosulfan II	<0.0000018	44
		Endosulfan sulfate	<0.0000016	44
		Ethylbenzene	<0.000077	70
		gamma-BHC (Lindane)	<0.00000125	0.02
		Heptachlor epoxide	<0.000002	0.02
		Methylene chloride	0.00437J	0.5
		Naphthalene	<0.000053	57
		Nickel	<0.0009	15
		Phenanthrene	<0.000137	220
		Pyrene	<0.00009	220
		Tetrachloroethene	0.000881J	0.5
		Thallium	<0.0038	0.2
		Toluene	<0.000093	100
		Trichloroethene	0.00203J	0.5
		Vinyl chloride	<0.000163	0.2
NE3MW30B	12/3/2007	1,1,1-Trichloroethane	**64**[(3)]	1.6
		1,1-Dichloroethene	**10.2J**	0.7
		1,2,3-Trichloropropane	**45.7**	0.029
		1,2-Dichloroethane	**176**	0.5
		1,2-Dichloropropane	<0.499	0.5
		Anthracene	<0.000104	2,200
		Benzene	**<0.921**	0.5
		Carbon tetrachloride	**<0.621**	0.5
		cis-1,2-Dichloroethene	<0.768	7
		Ethylbenzene	<0.387	70
		Methylene chloride	**738**	0.5
		Naphthalene	<1.84	57
		Nickel	<0.00084	15
		Phenanthrene	0.00576	220
		Pyrene	<0.000092	220
		Tetrachloroethene	**23.8J**	0.5
		Thallium	<0.0038	0.2
		Toluene	<0.466	100
		Trichloroethene	**170**	0.5
		Vinyl chloride	**<0.817**	0.2

TABLE 30 - ZONE B GROUNDWATER CONCENTRATIONS

Sample Location	Sample Date	Chemical of Interest	Concentration (mg/L)	Extent Evaluation Comparison Value (mg/L)[1]
NE4MW31B	6/18/2008	1,1,1-Trichloroethane	<0.000155	1.6
		1,1-Dichloroethene	<0.000226	0.7
		1,2,3-Trichloropropane	<0.000151	0.029
		1,2-Dichloroethane	<0.000184	0.5
		Benzene	<0.000184	0.5
		Carbon tetrachloride	<0.000124	0.5
		cis-1,2-Dichloroethene	0.000423J	7
		Methylene chloride	0.00218J	0.5
		Tetrachloroethene	<0.000081	0.5
		Trichloroethene	<0.000123	0.5
		Vinyl chloride	<0.000163	0.2
NG3MW25B	6/6/2007	1,1,1-Trichloroethane	<0.000155	1.6
		1,1-Dichloroethene	<0.000226	0.7
		1,2,3-Trichloropropane	<0.000151	0.029
		1,2-Dichloroethane	<0.000184	0.5
		1,2-Dichloropropane	<0.0001	0.5
		4,4'-DDE	<0.00000195	0.6
		Anthracene	<0.000102	2200
		Benzene	<0.000184	0.5
		Carbon tetrachloride	<0.000124	0.5
		cis-1,2-Dichloroethene	<0.000154	7
		Dieldrin	<0.00000425	0.013
		Endosulfan II	<0.0000018	44
		Endosulfan sulfate	<0.0000016	44
		Ethylbenzene	<0.000077	70
		gamma-BHC (Lindane)	<0.00000125	0.02
		Heptachlor epoxide	<0.000002	0.02
		Methylene chloride	<0.000675	0.5
		Naphthalene	<0.000053	57
		Nickel	<0.0009	15
		Phenanthrene	<0.000137	220
		Pyrene	<0.00009	220
		Tetrachloroethene	<0.000081	0.5
		Thallium	<0.0038	0.2
		Toluene	<0.000093	100
		Trichloroethene	<0.000123	0.5
		Vinyl chloride	<0.000163	0.2

TABLE 30 - ZONE B GROUNDWATER CONCENTRATIONS

Sample Location	Sample Date	Chemical of Interest	Concentration (mg/L)	Extent Evaluation Comparison Value (mg/L)[1]
OMW27B	6/4/2007	1,1,1-Trichloroethane	<0.000155	1.6
		1,1-Dichloroethene	<0.000226	0.7
		1,2,3-Trichloropropane	<0.000151	0.029
		1,2-Dichloroethane	<0.000184	0.5
		1,2-Dichloropropane	<0.0001	0.5
		4,4'-DDE	<0.00000195	0.6
		Anthracene	<0.000102	2200
		Benzene	<0.000184	0.5
		Carbon tetrachloride	<0.000124	0.5
		cis-1,2-Dichloroethene	<0.000154	7
		Dieldrin	<0.00000425	0.013
		Endosulfan II	<0.0000018	44
		Endosulfan sulfate	<0.0000016	44
		Ethylbenzene	<0.000077	70
		gamma-BHC (Lindane)	<0.00000125	0.02
		Heptachlor epoxide	<0.000002	0.02
		Methylene chloride	<0.000774	0.5
		Naphthalene	<0.000053	57
		Nickel	<0.00045	15
		Phenanthrene	<0.000137	220
		Pyrene	<0.00009	220
		Tetrachloroethene	<0.000081	0.5
		Thallium	<0.0019	0.2
		Toluene	<0.000093	100
		Trichloroethene	<0.000123	0.5
		Vinyl chloride	<0.000163	0.2

Notes:
(1) Extent Evaluation Comparison Values from Table 28 (human health PSVs only).
(2) Data qualifiers: J = estimated value.
(3) Bolded values and detection limits exceed extent evaluation comparison value.

TABLE 31 - ZONE C GROUNDWATER CONCENTRATIONS

Sample Location	Sample Date	Chemical of Interest	Concentration (mg/L)	Extent Evaluation Comparison Value (mg/L)[1]
NE4MW32C	6/18/2008	1,1,1-Trichloroethane	0.709	20
		1,1-Dichloroethene	<0.000226	0.7
		1,2,3-Trichloropropane	**0.321**	0.029
		1,2-Dichloroethane	<0.000184	0.5
		Benzene	0.0459J[(2)]	0.5
		Carbon tetrachloride	<0.000124	0.5
		cis-1,2-Dichloroethene	4.62	7
		Methylene chloride	<0.000104	0.5
		Tetrachloroethene	**1.35**[(3)]	0.5
		Trichloroethene	**1.89**	0.5
		Vinyl chloride	<0.000163	0.2
	7/31/2008	1,1,1-Trichloroethane	0.18	20
		1,1-Dichloroethene	0.0379	0.7
		1,2,3-Trichloropropane	**0.219**	0.029
		1,2-Dichloroethane	<0.0018	0.5
		Benzene	0.0548	0.5
		Carbon tetrachloride	<0.00312	0.5
		cis-1,2-Dichloroethene	3.27	7
		Methylene chloride	<0.00192	0.5
		Tetrachloroethene	<0.00306	0.5
		Trichloroethene	<0.00236	0.5
		Vinyl chloride	<0.00310	0.2
	9/30/2008	1,1,1-Trichloroethane	<0.000096	20
		1,1-Dichloroethene	0.00177J	0.7
		1,2,3-Trichloropropane	0.0119	0.029
		1,2-Dichloroethane	<0.00009	0.5
		Benzene	0.0012J	0.5
		Carbon tetrachloride	<0.000156	0.5
		cis-1,2-Dichloroethene	0.168	7
		Methylene chloride	<0.000096	0.5
		Tetrachloroethene	0.00648	0.5
		Trichloroethene	0.00639	0.5
		Vinyl chloride	<0.000155	0.2
	1/13/2009	1,1,1-Trichloroethane	<0.000096	20
		1,1-Dichloroethene	0.00143J	0.7
		1,2,3-Trichloropropane	0.0042J	0.029
		1,2-Dichloroethane	<0.00009	0.5
		Benzene	0.00141J	0.5
		Carbon tetrachloride	<0.000156	0.5
		cis-1,2-Dichloroethene	0.112	7
		Methylene chloride	<0.000096	0.5
		Tetrachloroethene	<0.000153	0.5
		Trichloroethene	0.0341	0.5
		Vinyl chloride	<0.000155	0.2
NG3CPT1	7/31/2008	1,1,1-Trichloroethane	<0.000096	20
		1,1-Dichloroethene	<0.000201	0.7
		1,2,3-Trichloropropane	<0.000091	0.029
		1,2-Dichloroethane	<0.000090	0.5
		Benzene	<0.000065	0.5
		Carbon tetrachloride	<0.000156	0.5
		cis-1,2-Dichloroethene	<0.000162	7
		Methylene chloride	<0.000096	0.5
		Tetrachloroethene	<0.000153	0.5
		Trichloroethene	<0.000118	0.5
		Vinyl chloride	<0.000155	0.2

TABLE 31 - ZONE C GROUNDWATER CONCENTRATIONS

Sample Location	Sample Date	Chemical of Interest	Concentration (mg/L)	Extent Evaluation Comparison Value (mg/L)[1]
NE4CPT2	7/31/2008	1,1,1-Trichloroethane	<0.000096	20
		1,1-Dichloroethene	<0.000201	0.7
		1,2,3-Trichloropropane	<0.000091	0.029
		1,2-Dichloroethane	<0.000090	0.5
		Benzene	<0.000065	0.5
		Carbon tetrachloride	<0.000156	0.5
		cis-1,2-Dichloroethene	<0.000162	7
		Methylene chloride	<0.000096	0.5
		Tetrachloroethene	<0.000153	0.5
		Trichloroethene	<0.000118	0.5
		Vinyl chloride	<0.000155	0.2
NC2CPT3	7/31/2008	1,1,1-Trichloroethane	<0.000096	20
		1,1-Dichloroethene	<0.000201	0.7
		1,2,3-Trichloropropane	<0.000091	0.029
		1,2-Dichloroethane	<0.000090	0.5
		Benzene	<0.000065	0.5
		Carbon tetrachloride	<0.000156	0.5
		cis-1,2-Dichloroethene	<0.000162	7
		Methylene chloride	<0.000096	0.5
		Tetrachloroethene	<0.000153	0.5
		Trichloroethene	<0.000118	0.5
		Vinyl chloride	<0.000155	0.2
OCPT4	7/31/2008	1,1,1-Trichloroethane	<0.000096	20
		1,1-Dichloroethene	<0.000201	0.7
		1,2,3-Trichloropropane	<0.000091	0.029
		1,2-Dichloroethane	<0.000090	0.5
		Benzene	<0.000065	0.5
		Carbon tetrachloride	<0.000156	0.5
		cis-1,2-Dichloroethene	<0.000162	7
		Methylene chloride	<0.000096	0.5
		Tetrachloroethene	<0.000153	0.5
		Trichloroethene	<0.000118	0.5
		Vinyl chloride	<0.000155	0.2
OCPT5	1/13/2009	1,1,1-Trichloroethane	<0.000096	20
		1,1-Dichloroethene	<0.000201	0.7
		1,2,3-Trichloropropane	<0.000091	0.029
		1,2-Dichloroethane	<0.000090	0.5
		Benzene	<0.000065	0.5
		Carbon tetrachloride	<0.000156	0.5
		cis-1,2-Dichloroethene	<0.000162	7
		Methylene chloride	<0.000096	0.5
		Tetrachloroethene	<0.000153	0.5
		Trichloroethene	<0.000118	0.5
		Vinyl chloride	<0.000155	0.2

Notes:
(1) Extent Evaluation Comparison Values from Table 28 (human health PSVs only).
(2) Data qualifiers: J = estimated value.
(3) Bolded values exceed extent evaluation comparison value.

TABLE 32 ZONE A CHLORINATED ETHENE CONCENTRATIONS AND MOLAR RATIOS

		Concentration (mg/L)				Molar Concentration (mmoles/L)					Chlorinated Ethene Mole Fraction			
Sample Location	Date Sampled	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	PCE	TCE	cis 1,2-DCE	Vinyl Chloride	Total Chlorinated Ethenes	PCE	TCE	cis 1,2-DCE	Vinyl Chloride
NC2MW28	6/5/2007	<0.000081	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/7/2007	<0.0000805	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/17/2008	<0.000081	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND2MW01	8/3/2006	20.5	84	13.4	<0.178	1.24E-01	6.39E-01	1.38E-01	ND	9.01E-01	0.14	0.71	0.15	ND
	11/8/2007	<0.016	0.31 J	19.2	0.331 J	ND	2.36E-03	1.98E-01	5.30E-03	2.06E-01	ND	0.01	0.96	0.03
	6/18/2008	<0.0161	0.104 J	12.5	0.978 J	ND	7.92E-04	1.29E-01	1.56E-02	1.45E-01	ND	0.01	0.89	0.11
ND3MW02	8/3/2006	1.92	6.04	4.19	<0.00445	1.16E-02	4.60E-02	4.32E-02	ND	1.01E-01	0.11	0.46	0.43	ND
	11/8/2007	2.1	17.7	9.37	<0.041	1.27E-02	1.35E-01	9.67E-02	ND	2.44E-01	0.05	0.55	0.40	ND
	6/18/2008	34.8	76	13.6	<0.163	2.10E-01	5.78E-01	1.40E-01	ND	9.29E-01	0.23	0.62	0.15	ND
ND3MW29	6/5/2007	<1.61	61.2 J	<3.07	<3.27	ND	4.66E-01	ND	ND	4.66E-01	ND	1.00	ND	ND
	11/8/2007	<1.61	69.4 J	<3.07	<3.27	ND	5.28E-01	ND	ND	5.28E-01	ND	1.00	ND	ND
	6/18/2008	12.9 J	135	24.9 J	<1.63	7.78E-02	1.03E+00	2.57E-01	ND	1.36E+00	0.06	0.75	0.19	ND
ND4MW03	8/2/2006	<0.000227	<0.00027	<0.000163	<0.000089	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/8/2007	<0.000403	<0.000614	<0.000768	<0.000817	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/17/2008	<0.000081	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
NE1MW04	8/3/2006	<0.000227	0.00777	0.048	0.00237 J	ND	5.91E-05	4.95E-04	3.79E-05	5.92E-04	ND	0.10	0.84	0.06
	11/8/2007	<0.0000805	<0.000123	0.00331 J	<0.000163	ND	ND	3.41E-05	ND	3.41E-05	ND	ND	1.00	ND
	6/17/2008	<0.000081	<0.000123	0.00925	<0.000163	ND	ND	9.54E-05	ND	9.54E-05	ND	ND	1.00	ND
NE3MW05	8/2/2006	<0.00227	<0.0027	<0.00163	<0.00089	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/7/2007	<0.000322	<0.000491	<0.000614	<0.000654	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/17/2008	<0.000081	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
NF2MW06	8/3/2006	0.049	0.506	0.099	<0.00089	2.95E-04	3.85E-03	1.02E-03	ND	5.17E-03	0.06	0.75	0.20	ND
	11/8/2007	<0.0000805	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/18/2008	<0.000081	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
OMW-20	6/4/2007	<0.000081	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/7/2007	<0.0000805	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/18/2008	<0.000081	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
OMW-21	6/4/2007	<0.000081	0.00047 J	<0.000154	<0.000163	ND	3.58E-06	ND	ND	3.58E-06	ND	1.00	ND	ND
	11/7/2007	<0.0000805	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/17/2008	<0.000081	<0.000123	<0.000154	<0.000163	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
PCE = Tetrachloroethene
TCE = Trichloroethene
cis-1,2-DCE = cis-1,2-dichloroethene
ND = Not Detected.
Data Qualifier: J = estimated value.

TABLE 33 BIODEGRADATION EALUATION PARAMETERS

Well ID	Sample Date	Dissolved Oxygen[1] (mg/L)	Oxidation Reduction Potential[2] (mV)	pH	Temp. (°C)	Fe(II)[3] (mg/L)	Nitrate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	Total Organic Carbon (mg/L)	BTEX[4] (mg/l)	Ethene/ Ethane (mg/L)
NC2MW28	11/7/2007	0.53	-48.9	6.56	23.4	>3	<0.008	0.221	0.0177 J+	<6.1	ND	0.000278
NC2MW28	6/17/2008	0.23	-122.6	6.63	24.4	>3	<0.008	0.257 J-	0.0185	8.1	ND	0.000278
ND2MW01	11/8/2007	0.44	-77.4	6.58	26.1	>3	<0.008	1.41	<0.26	11.1	0.518 J	2.7588
ND2MW01	6/18/2008	0.11	-79.1	6.54	26.2	>3	<0.008	0.008	<0.521	13.3	0.691 J	7.2276
ND3MW02	11/8/2007	0.68	-64.2	6.34	24.7	>3	<0.008	<0.008	0.00717	13.2	0.158 J	0.002736
ND3MW02	6/18/2008	0.40	-62.1	6.47	25.6	>3	<0.008	0.008	0.00445 J	18.8	0.691 J	0.00166
ND3MW29	11/8/2007	0.81	-58.6	6.17	25.6	>30	<0.008	0.131	<0.26	401	ND	1.2288
ND3MW29	6/18/2008	0.29	-78.4	5.79	25.7	>3	<0.008	0.119 J-	<0.521	568	5.92	4.3876
ND4MW03	11/8/2007	0.90	-72.9	6.83	25.9	>3	0.038	<0.008	0.0285	11.8	ND	0.000278
ND4MW03	6/17/2008	0.27	-127.6	6.81	24.4	>3	<0.008	<0.008 J	0.00723	5.3	ND	0.000278
NE1MW04	11/8/2007	0.45	-57.4	6.48	25.2	>3	<0.008	0.034	0.0242	10.5	ND	0.000278
NE1MW04	6/17/2008	0.09	-65.2	6.54	24.6	>3	<0.008	0.054 J-	0.0117	7	ND	0.000278
NE3MW05	11/7/2007	0.71	-168.6	7.93	24.6	2.2	<0.008	0.015 J	7.95	29.4	0.278	0.0835
NE3MW05	6/17/2008	0.27	-127.3	7.21	26.3	>3	<0.008	0.106 J-	8.69	28	0.0272	0.0835
NF2MW06	11/8/2007	0.46	-18.7	6.85	26.3	>3	2.63	<0.008	<0.000868	20.7	ND	0.000278
NF2MW06	6/18/2008	0.39	-16.9	6.87	25.9	NM	<0.021	0.008	0.00723 J-	22.3	ND	0.000278
OMW20	11/7/2007	0.32	-21.3	6.89	25.7	>3	0.008	3.89 J-	0.0087	13.8	ND	0.002366
OMW20	6/18/2008	0.21	-32.6	6.94	26.2	>3	0.709	0.117 J-	0.00348 J	6.3	ND	0.000278
OMW21	11/7/2007	0.44	-81.7	6.48	25.2	>3	0.077 J	0.133 J-	0.00656	<7	ND	0.000278
OMW21	6/17/2008	0.11	-125.9	6.73	24.6	>3	<0.008	0.094 J-	0.00333 J	5.6	ND	0.000278

Notes:
1. Field measurement corrected for salinity based on specific conductivity measurements per UGSG, 2006.
2. Field measured oxidation reduction potential using silver/silver chloride electrode.
3. Field measurement.
4. Sum of benzene, toluene, ethylbenzene, and xylene concentrations. Compounds not detected set at 0 for sum calculation. ND = no BTEX compounds detected.
5. NM = Not Measured.
6. Data qualifiers: J = estimated value, J+ = estimated value, biased high, J- = estimated value biased low.

FIGURES

QUADRANGLE LOCATION

N

Scale in Feet

0 1000 2000

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 1

SITE LOCATION MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076854

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Lot Boundary (approximate)

N

Approx. Scale in Feet

0 125 250

Source of photo: H-GAC, Texas aerial photograph, 2006.

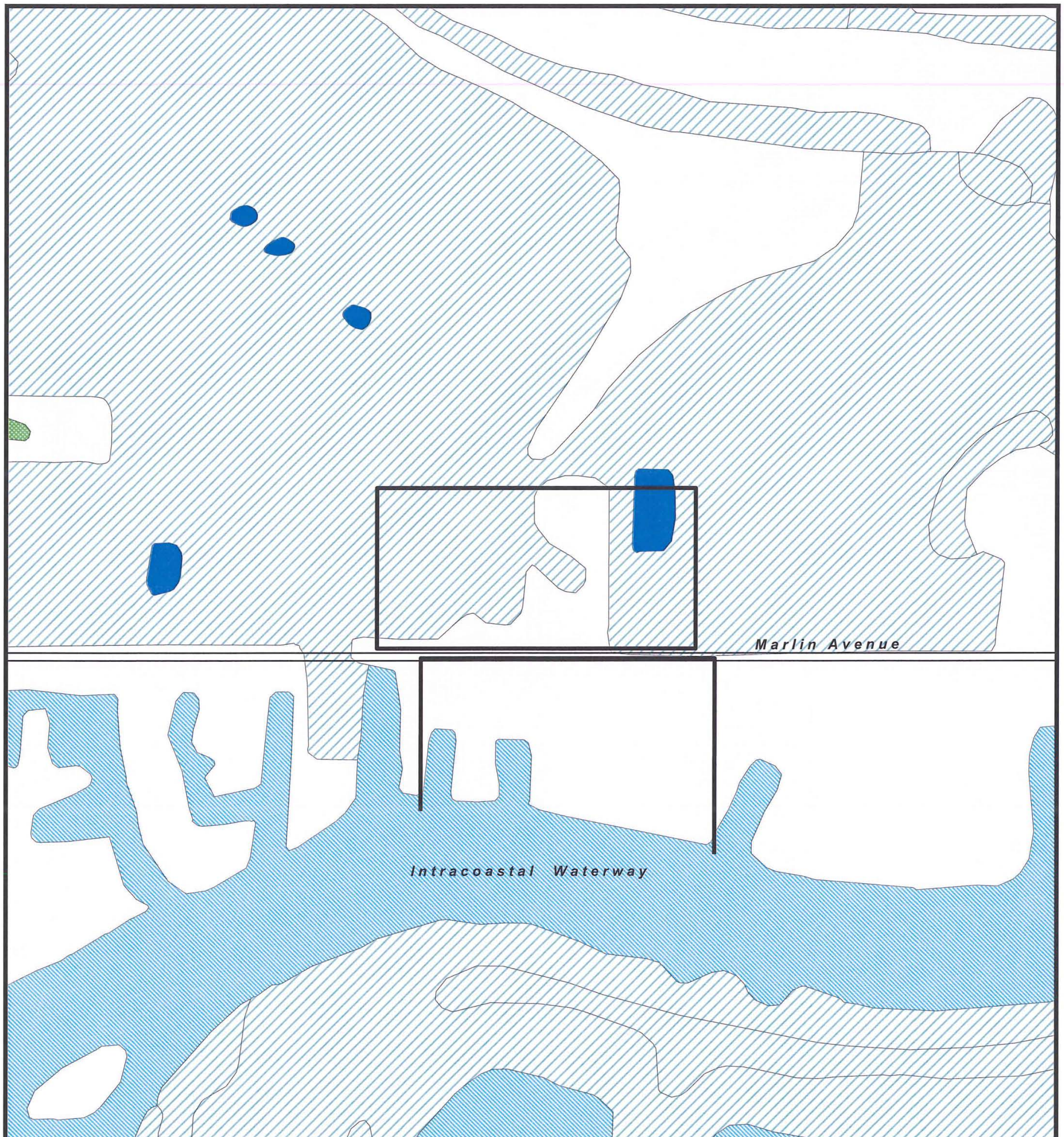
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 2

SITE MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- Approx. Site Boundary
- Upland Area
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Pond

N

Approx. Scale in Feet

0 300 600

Source:
U.S. Fish & Wildlife Service, Wetlands Online Mapper, 2008.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 3

WETLAND MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location - Zone A
- Temporary Piezometer - Zone A
- Staff Gauge
- Previous Monitoring Well Location
- Monitoring Well Location - Zone B
- Soil Boring Location - Zone B
- Monitoring Well Location - Zone C
- CPT Piezometer Location - Zone C
- Deep Soil Boring Location

Source of photo: H-GAC, Texas aerial photograph, 2006.

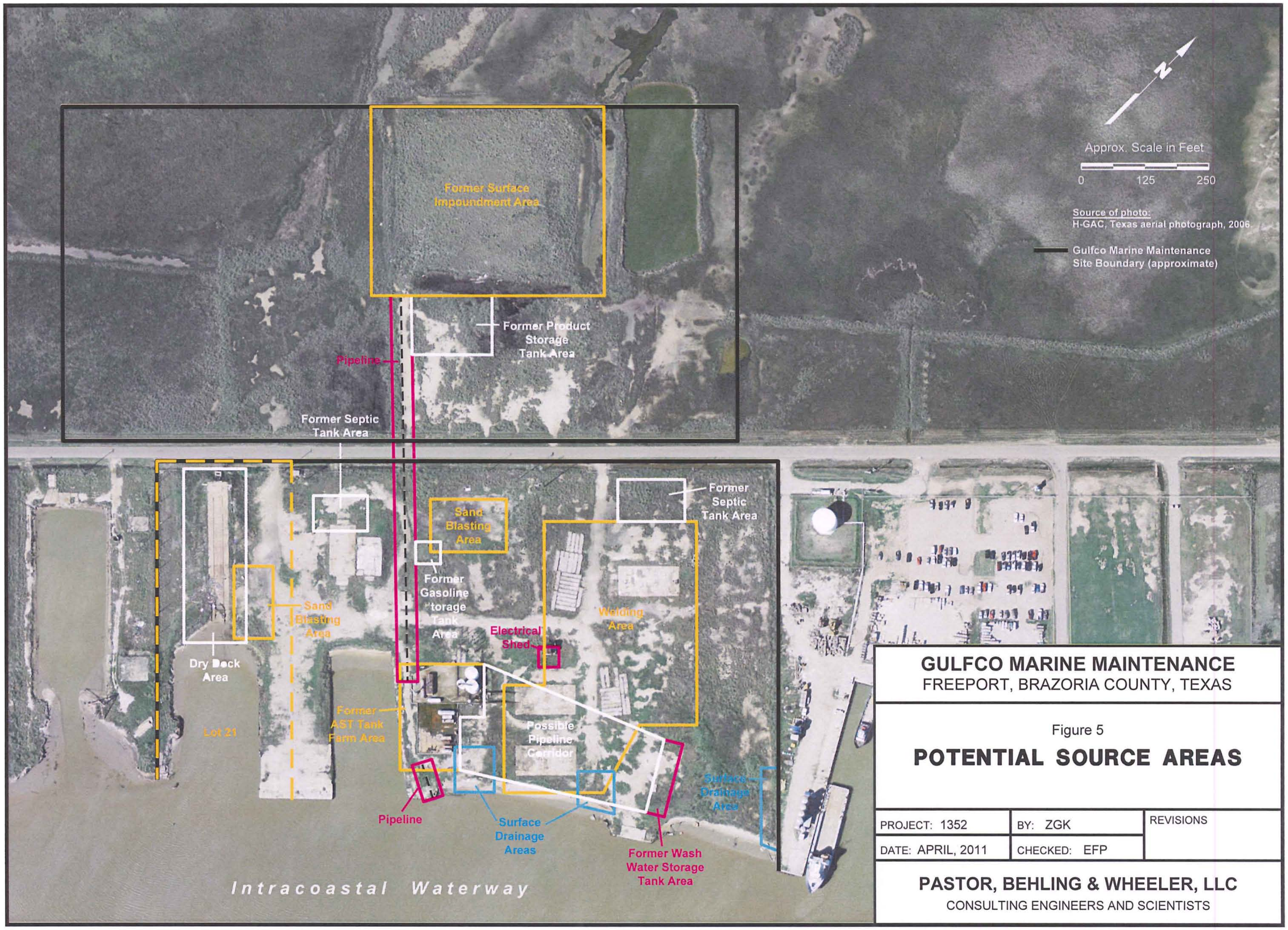
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 4

GROUNDWATER INVESTIGATION LOCATIONS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 5

POTENTIAL SOURCE AREAS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

T13E-W EM Survey Transect and ID

● Single RD Detection

Electromagnetic Conductivity Contour (MS) (Milisiemens)

- 500
- 750
- 1000
- 2000
- 3000
- 4000
- 5000
- 6000
- 7000
- 8000

N

Approx. Scale in Feet

0 50 100

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 6

EM SURVEY TRANSECTS AND DATA

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076859

Marlin Avenue
GULFCO SITE
Intracoastal Waterway
Background Area
IWSE25
IWSW33
IWSE29
IWSE24
IWSE28
IWSW32
IWSE23
IWSE27
IWSW31
IWSE22
IWSW30
IWSE26
IWSE21
EXPLANATION
IWSE29 Sediment Station
IWSW30 Surface Water Station
Note:
Fish tissue samples collected from throughout background area.
N
Approx. Scale in Feet
0 125 250
Source of photo: H-GAC, Texas aerial photograph, 2006.
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS
Figure 7
INTRACOASTAL WATERWAY
RI BACKGROUND SAMPLE
LOCATIONS
PROJECT: 1352
BY: ZGK
REVISIONS
DATE: APRIL, 2011
CHECKED: EFP
PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076860

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Intracoastal Waterway Sediment Sample

Intracoastal Waterway Surface Water Sample

Attempted Intracoastal Waterway Sediment Sample

Zone 1 Crab/Fish Tissue Sampling Zones

N

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 8

INTRACOASTAL WATERWAY RI SITE SAMPLE LOCATIONS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076861

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- ● Shallow Soil Sample (0-2 ft)
- ■ Shallow (0-2 ft) and Deep (4-5 ft) Soil Sample
- Lot 20 Soil Sample

N

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 9

**SOUTH AREA
SOIL INVESTIGATION PROGRAM
SAMPLE LOCATIONS**

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076862

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Parcel Boundary (approximate)

Lot 21 Surface Soil Sample (0-1 in)

Lot 19/20 Surface Soil Sample (0-1 in)

N

Approx. Scale in Feet

0 60 120

Source of photo:
H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 10

RESIDENTIAL SURFACE SOIL INVESTIGATION PROGRAM SAMPLE LOCATIONS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- ● Shallow (0-2 ft) Soil Sample
- ▲ Shallow (0-2 ft) and Deep (4+ ft) Soil Sample
- ☒ Geotechnical Soil Boring

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 11

NORTH AREA RI SOIL SAMPLE LOCATIONS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076864

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- ▼ Wetland Sediment Sample Location
- △ Wetland/Pond Surface Water Sample Location
- ○ Pond Sediment Sample Location

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 12

RI WETLAND AND POND SAMPLE LOCATIONS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076865

EXPLANATION

Background Soil Area Boundary (per Figure 8 of Field Sampling Plan)

BSS-1 Approximate Background Soil Sample Location

Note:
Background Area located approximately 2,000 feet east of Gulfco site.

Approx. Scale in Feet

0 40 80

Source of photo:
H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 13

BACKGROUND SOIL SAMPLE LOCATIONS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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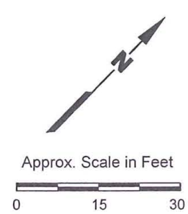
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 14

FORMER AST TANK FARM PRIOR TO REMOVAL ACTION

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

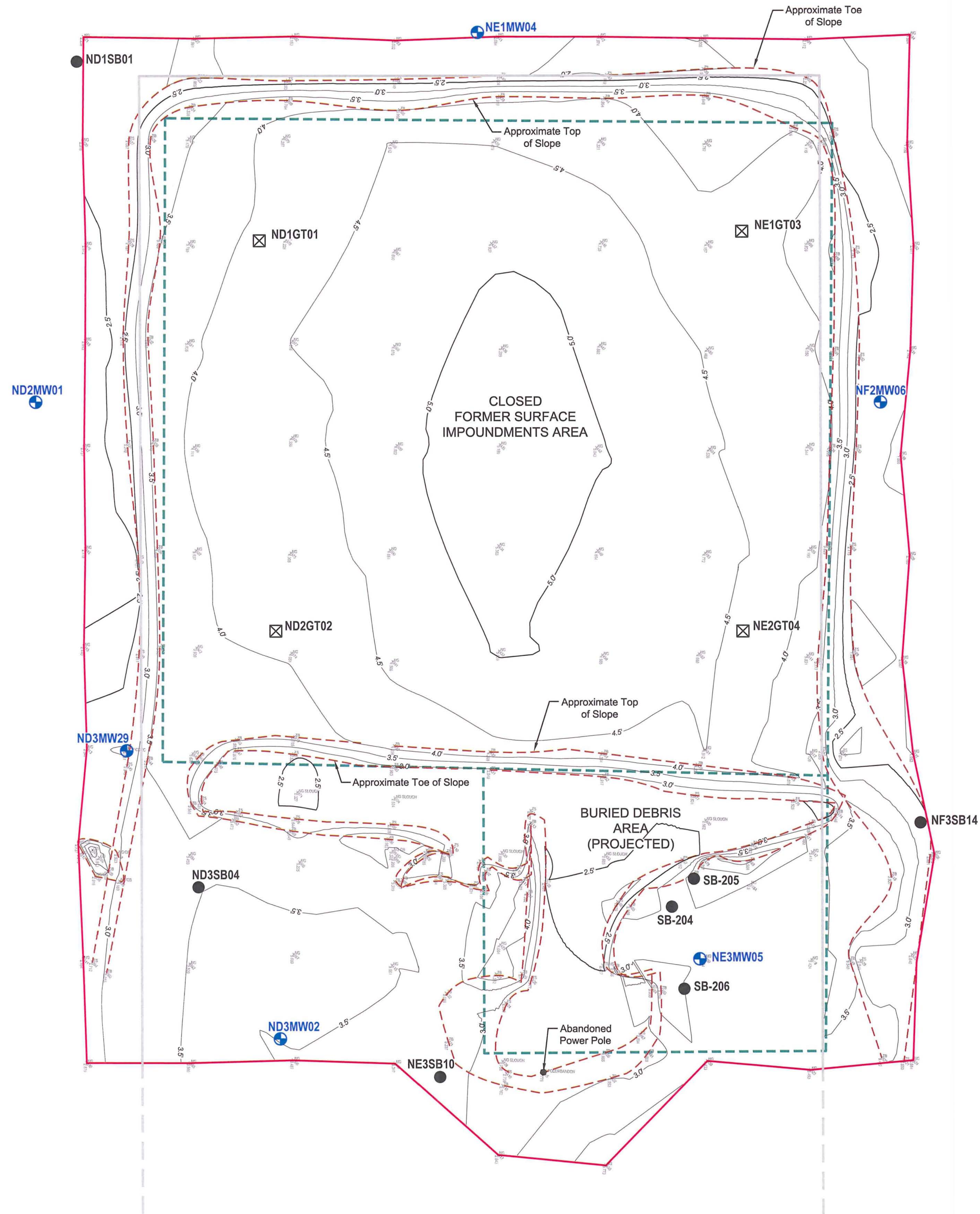
PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



Note:
Tank numbers, except 100, from LTE, 1999. Tank 100 (empty tank) removed by Hurricane Ike storm surge in September 2008. Other tanks removed as a part of a time critical removal action in December 2010-January 2011.

Source of photo: H-GAC, Texas aerial photograph, 2006.

076867



EXPLANATION

- Monitoring Well Location
- Geotechnical Soil Boring
- Soil Boring Location
- Elevation Measurement Location
- 2.0 Ground Surface Elevation (Ft Mean Sea Level, NGVD 29) - Minor Contour Line
- 2.5 Ground Surface Elevation (Ft Mean Sea Level, NGVD 29) - Major Contour Line
- Extent of Surface Impoundments and Buried Debris Area (Projected)
- Top/Toe of Slope (Approximate)
- Lot 56 Property Line
- Limits of Topographic Survey

N

Approx. Scale in Feet

0 25 50

Source: Doyle & Wachtstetter, Inc. Field Survey May 26, 2009.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

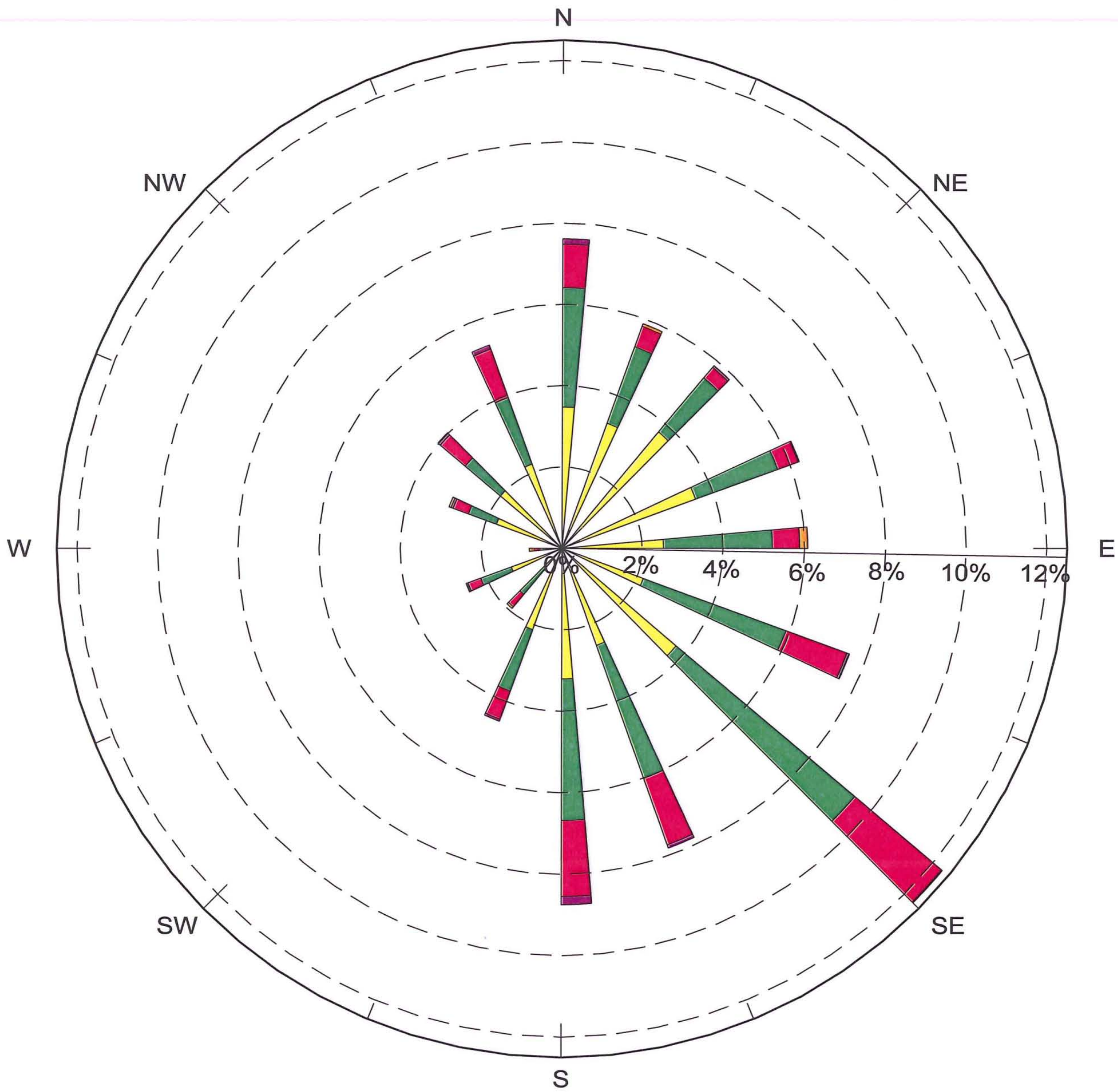
Figure 15

FORMER SURFACE IMPOUNDMENTS TOPOGRAPHIC MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076868



(blue)	>1 KT - 3 KTS
(yellow)	>4 KTS - 6 KTS
(green)	>7 KTS - 10 KTS
(red)	>11 KTS - 16 KTS
(purple)	>17 KTS - 21 KTS
(orange)	>21 KTS

Source:
Modified from TCEQ 2009, Houston Intercontinental Airport Wind Rose.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 16
ANNUAL WIND ROSE DIAGRAM HOUSTON INTERCONTINENTAL AIRPORT 1984 THROUGH 1992

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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EXPLANATION

FS
Fill and Spoil

Holocene

Qal
Alluvium

Qbr
Beach-ridge and barrier-flat sand deposits

QUATERNARY

N

SCALE
0 1
Statute Miles

Source: Geologic Atlas of Texas, Beeville-Bay City Sheet, 1987.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 17

REGIONAL GEOLOGY MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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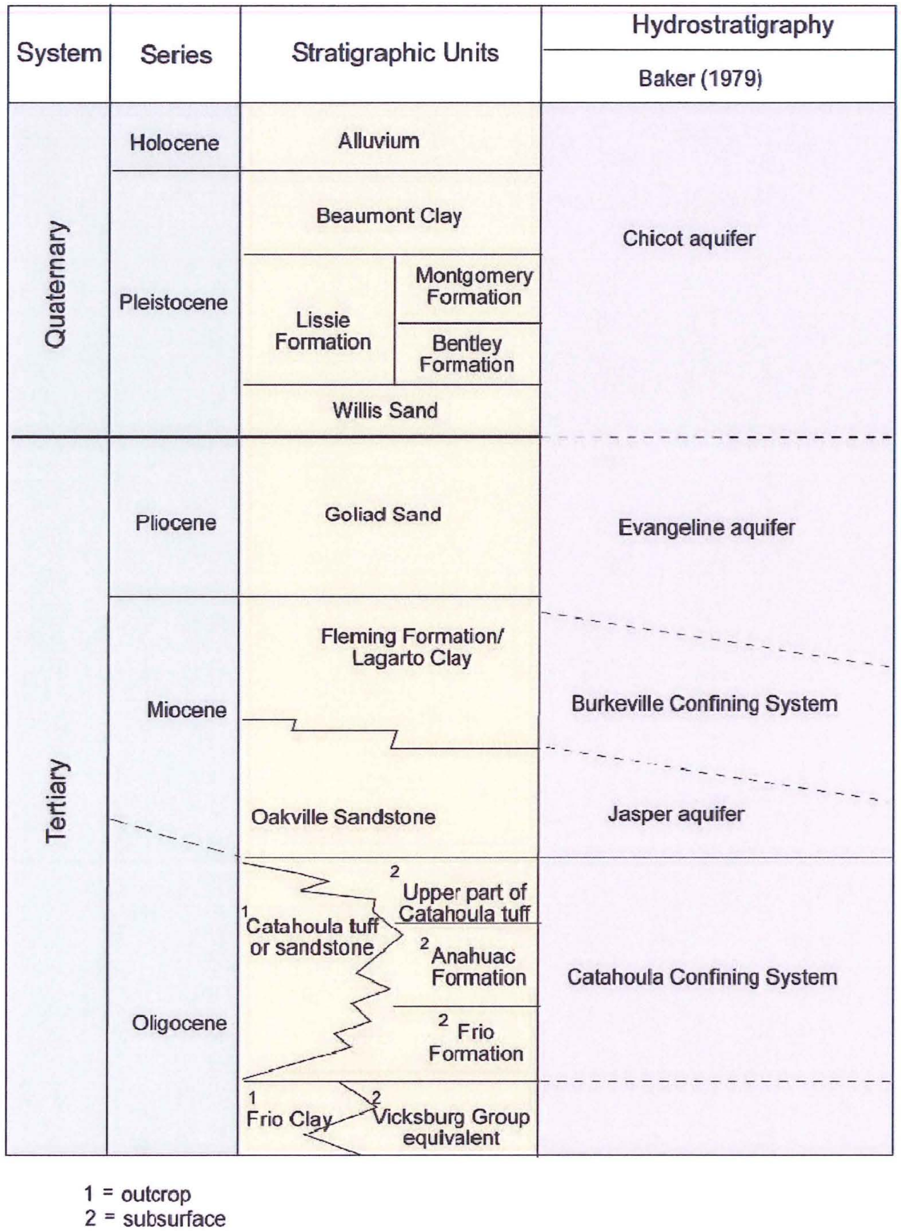
CONSULTING ENGINEERS AND SCIENTISTS



GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 18

REGIONAL STRATIGRAPHIC COLUMN

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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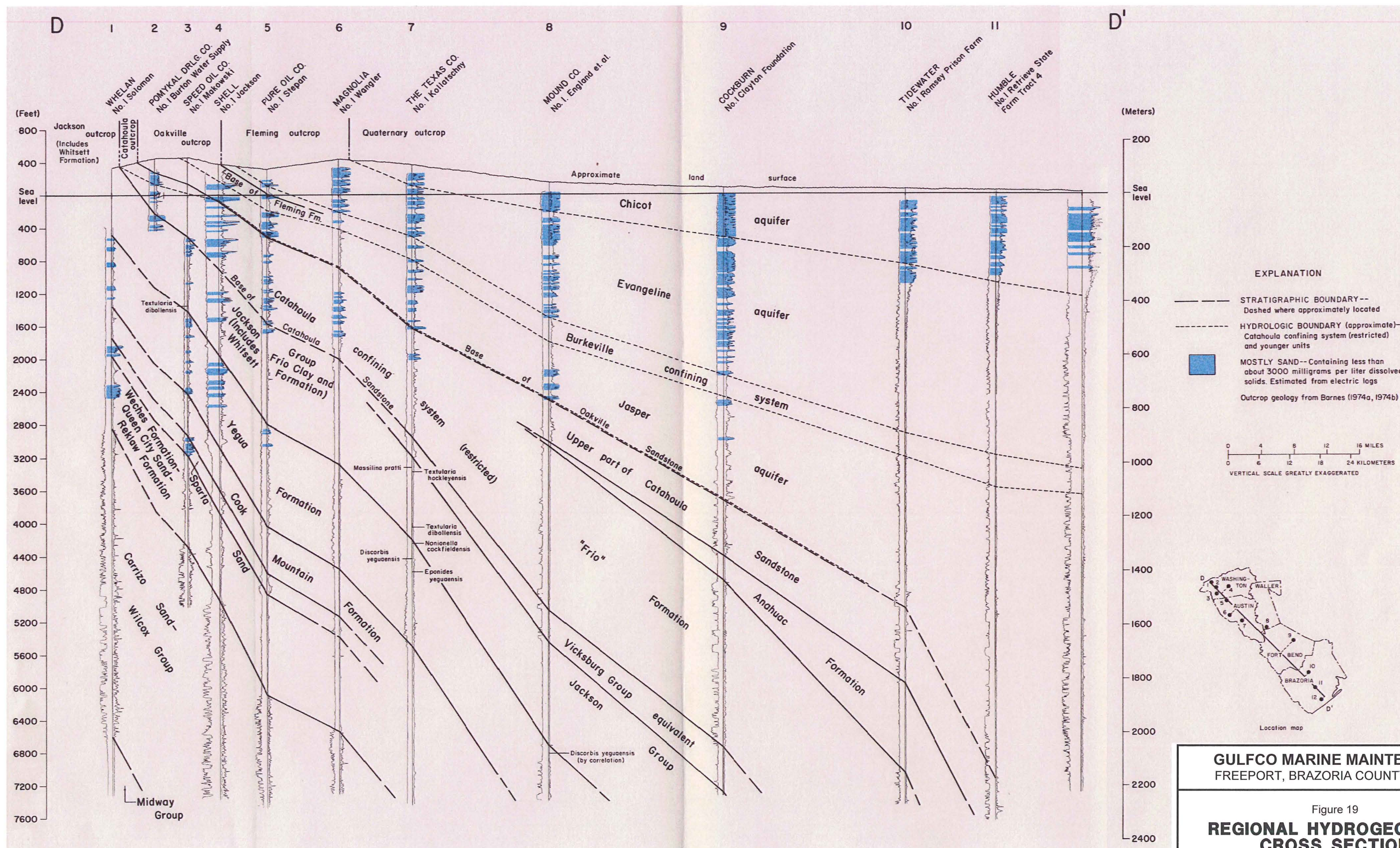
Source:
Davidson and Mace, 2006.



GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 19

REGIONAL HYDROGEOLOGIC CROSS SECTION

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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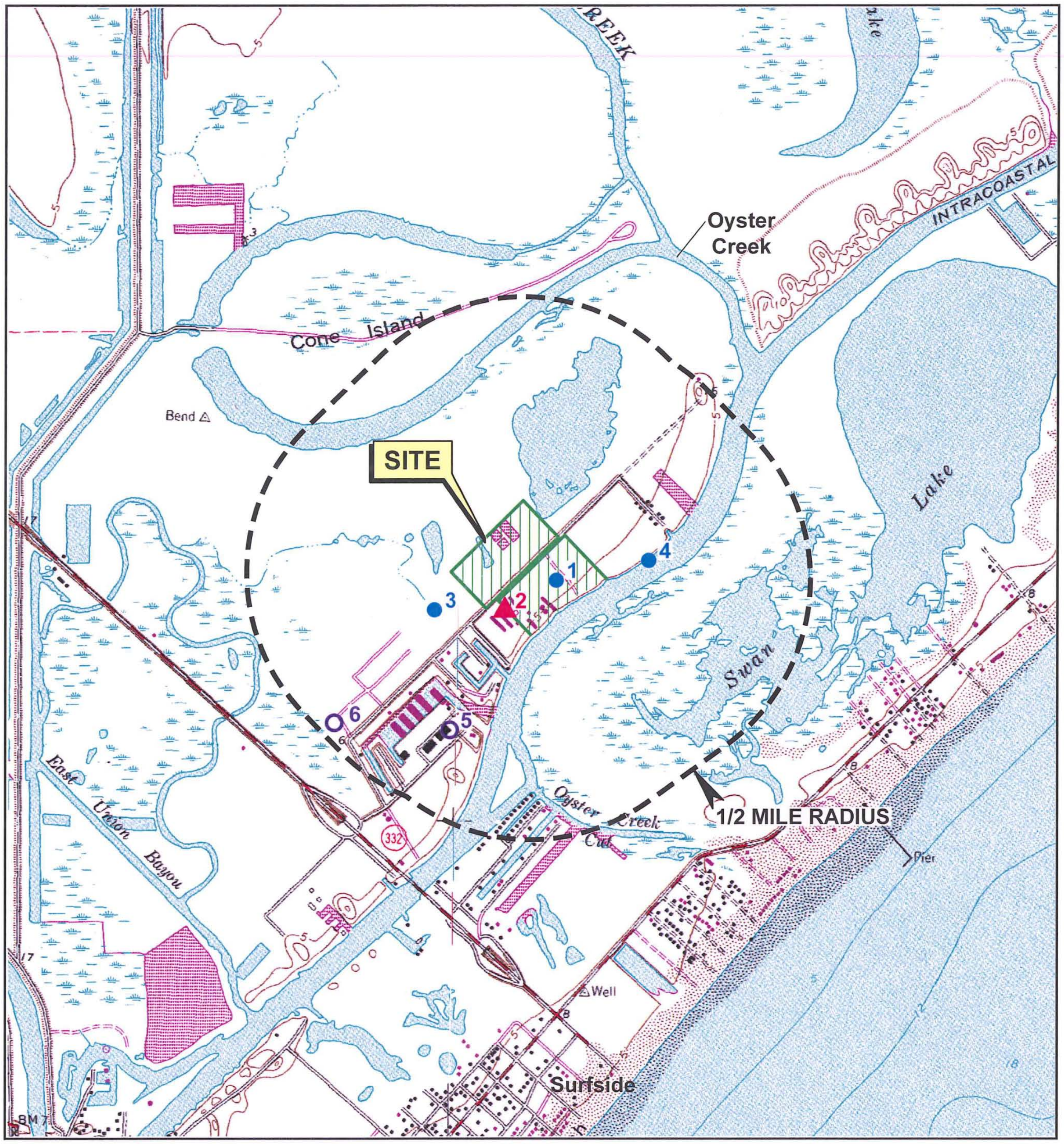
Source:
Baker, 1979.

076872



EXPLANATION

Approx. Site Boundary

Water Well Incorrectly Mapped in Water Well Records (Not Found During Field Survey)

Water Well Abandoned

Water Well Field Verified (Not in Use)

N

Scale in Feet

0 1000 2000

TEXAS

QUADRANGLE LOCATION

Notes:
See Table 8 for well owner and construction information.

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 20

WATER SUPPLY WELL LOCATIONS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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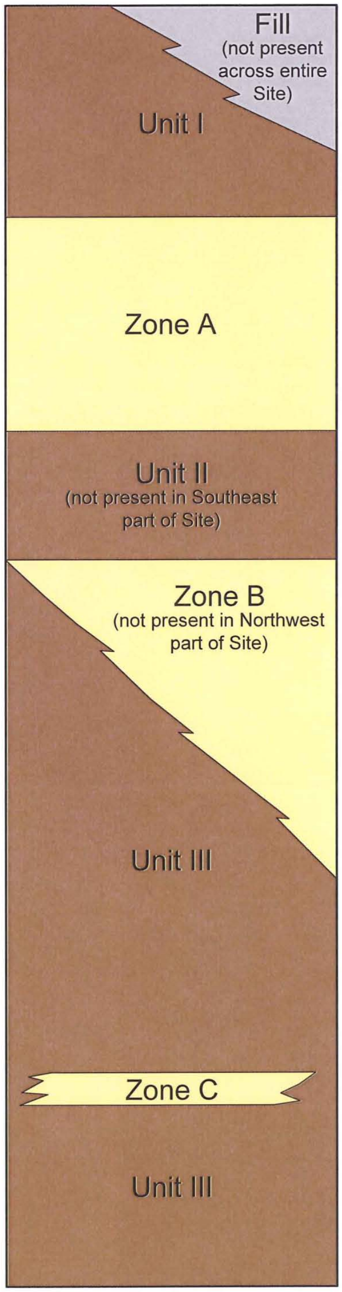

Not to Scale

EXPLANATION

FILL

CONFINING UNIT

WATER-BEARING ZONE

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 21

IDEALIZED SITE HYDROSTRATIGRAPHIC COLUMN

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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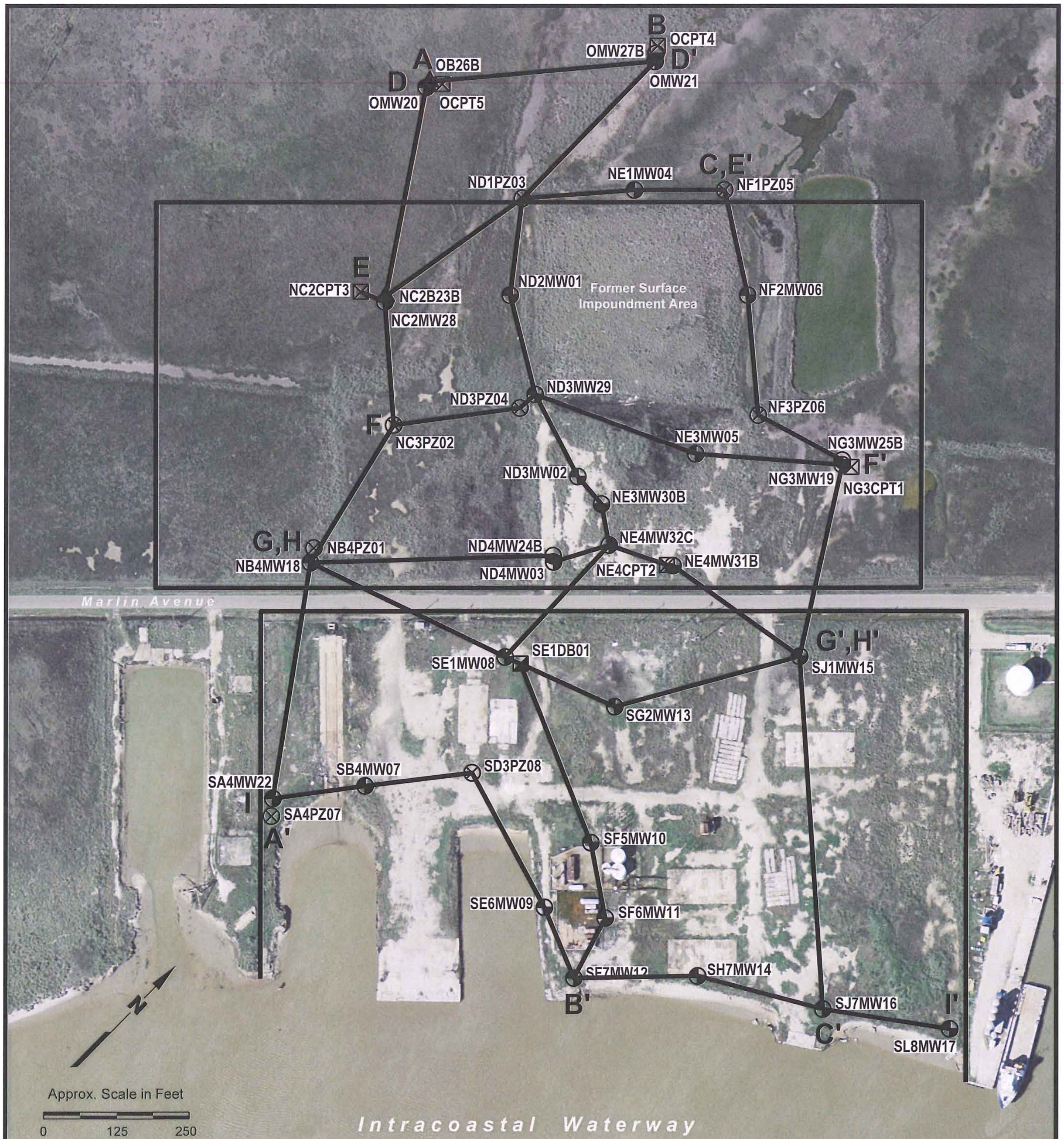


EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location - Zone A
- Temporary Piezometer - Zone A
- Monitoring Well Location - Zone B
- A A' Cross Section Location
- Soil Boring Location - Zone B
- Monitoring Well Location - Zone C
- CPT Piezometer Location - Zone C
- Deep Soil Boring Location

Source of photo: H-GAC, Texas aerial photograph, 2006.

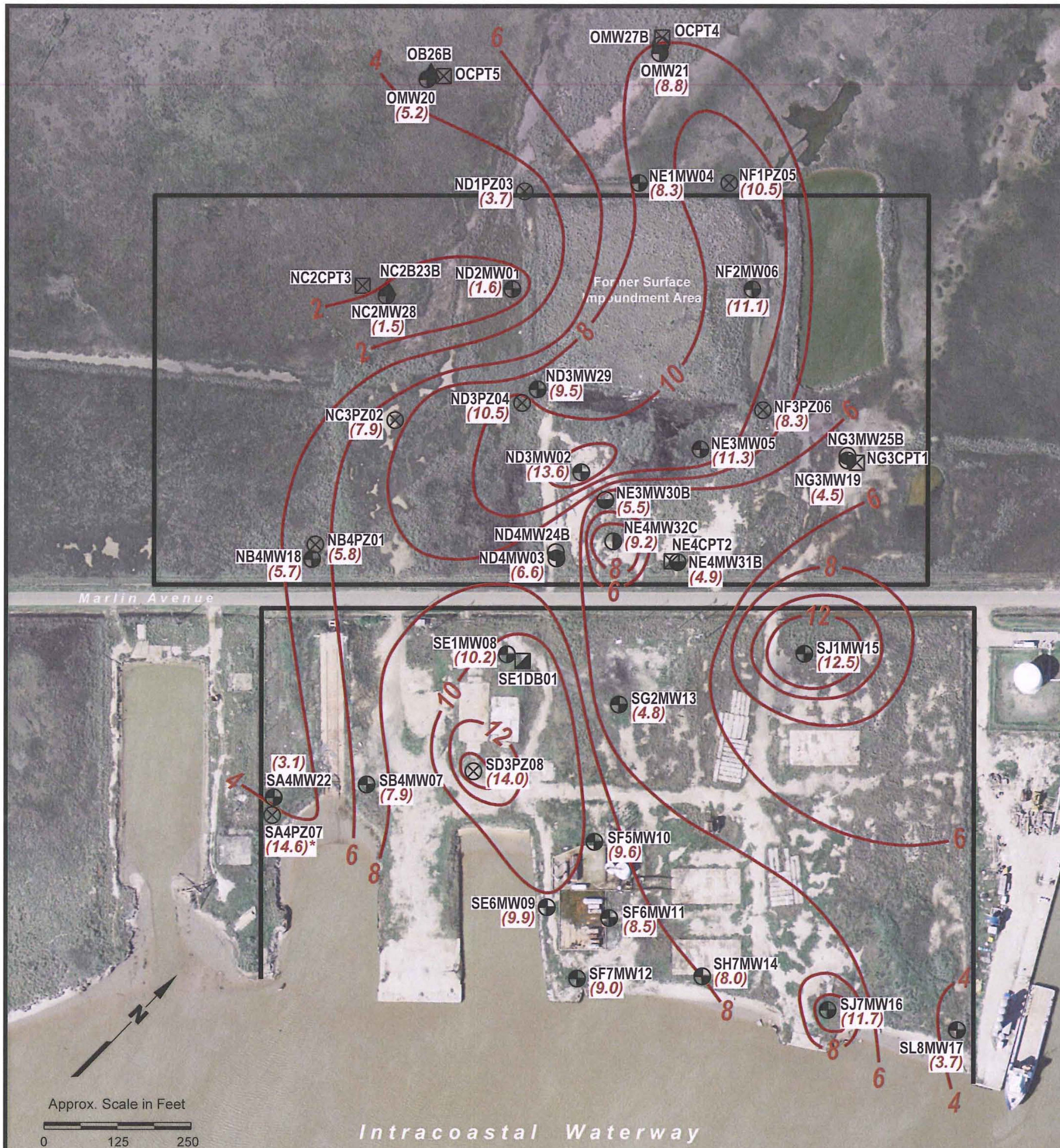
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 22

CROSS SECTION LOCATION MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

Symbol	Description	Symbol	Description
—	Gulfco Marine Maintenance Site Boundary (approximate)	⊠	CPT Piezometer Location - Zone C
	Monitoring Well Location - Zone A	▲	Soil Boring Location - Zone B
⊗	Temporary Piezometer - Zone A		Deep Soil Boring Location
	Monitoring Well Location - Zone B	(6.6)	Zone A Thickness (Ft)
	Monitoring Well Location - Zone C	—6—	Zone A Thickness Isopach (Contour Interval = 2 Ft)

Note: *Not used for contouring.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

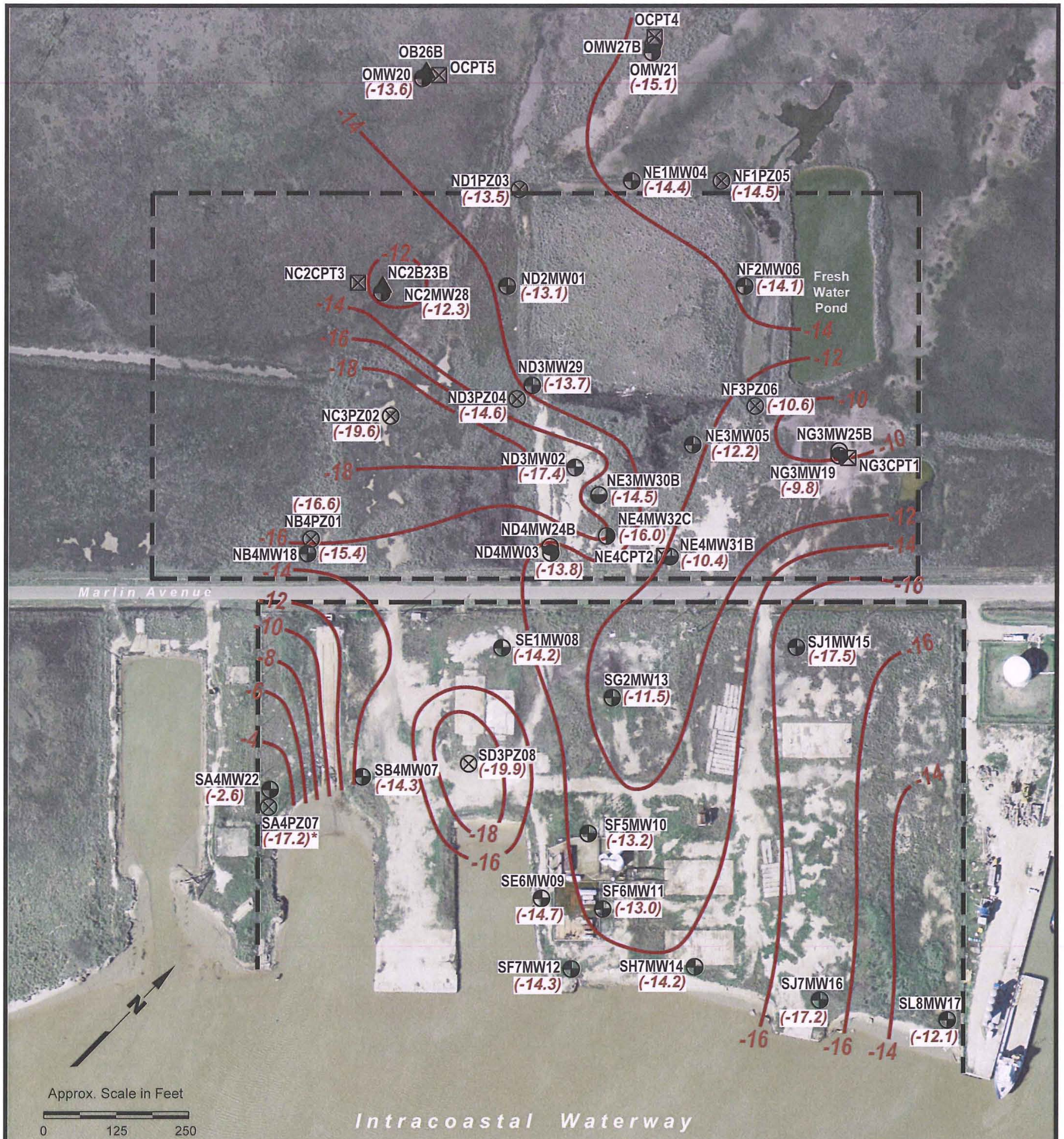
Figure 23

ZONE A THICKNESS MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076876



EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location - Zone A
- Temporary Piezometer - Zone A
- Monitoring Well Location - Zone B
- Monitoring Well Location - Zone C
- Soil Boring Location - Zone B
- *(-14.3)* Elevation of Base of Zone A (Ft MSL)
- *-14* Base of Zone A Contour (Contour Interval = 2 Ft)

Note:
*Zone A base elevation at co-located monitoring well/temporary piezometer locations based on monitoring well boring due to superior sample obtained from larger diameter boring.

Source of photo: H-GAC, Texas aerial photograph, 2006.

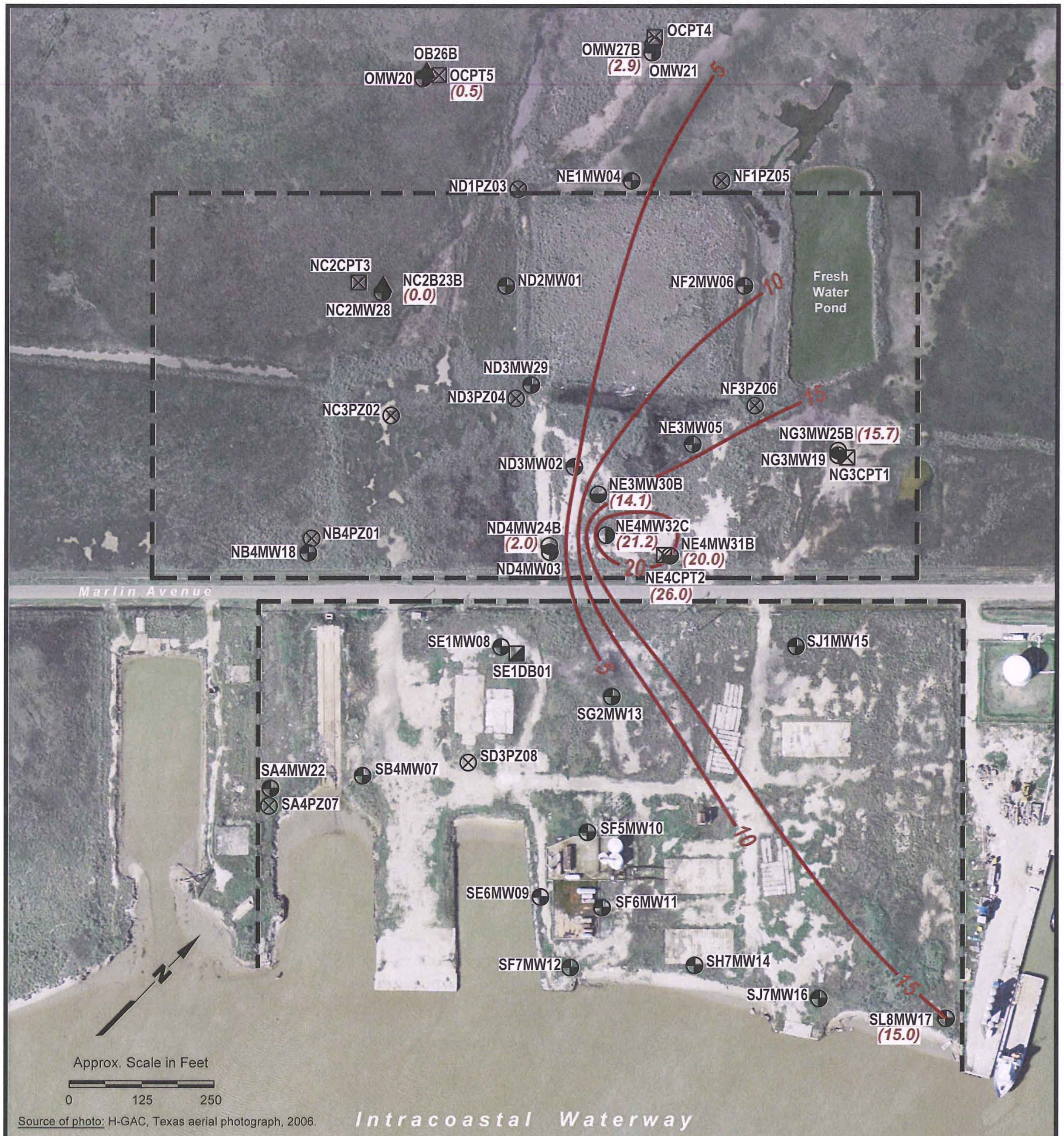
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 24

STRUCTURE CONTOUR MAP BASE OF ZONE A

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location - Zone A
- Temporary Piezometer - Zone A
- Monitoring Well Location - Zone B
- Monitoring Well Location - Zone C
- CPT Piezometer Location - Zone C
- Soil Boring Location - Zone B
- Deep Soil Boring Location
- (15.7) Zone B Thickness (Ft)
- 5 Zone B Thickness Isopach (Contour Interval = 5 Ft)

Note:
* Separating clay between Zone A and Zone B is not present at SL8MW17. Zone B thickness at this location is based on the thickness of the SP sand.

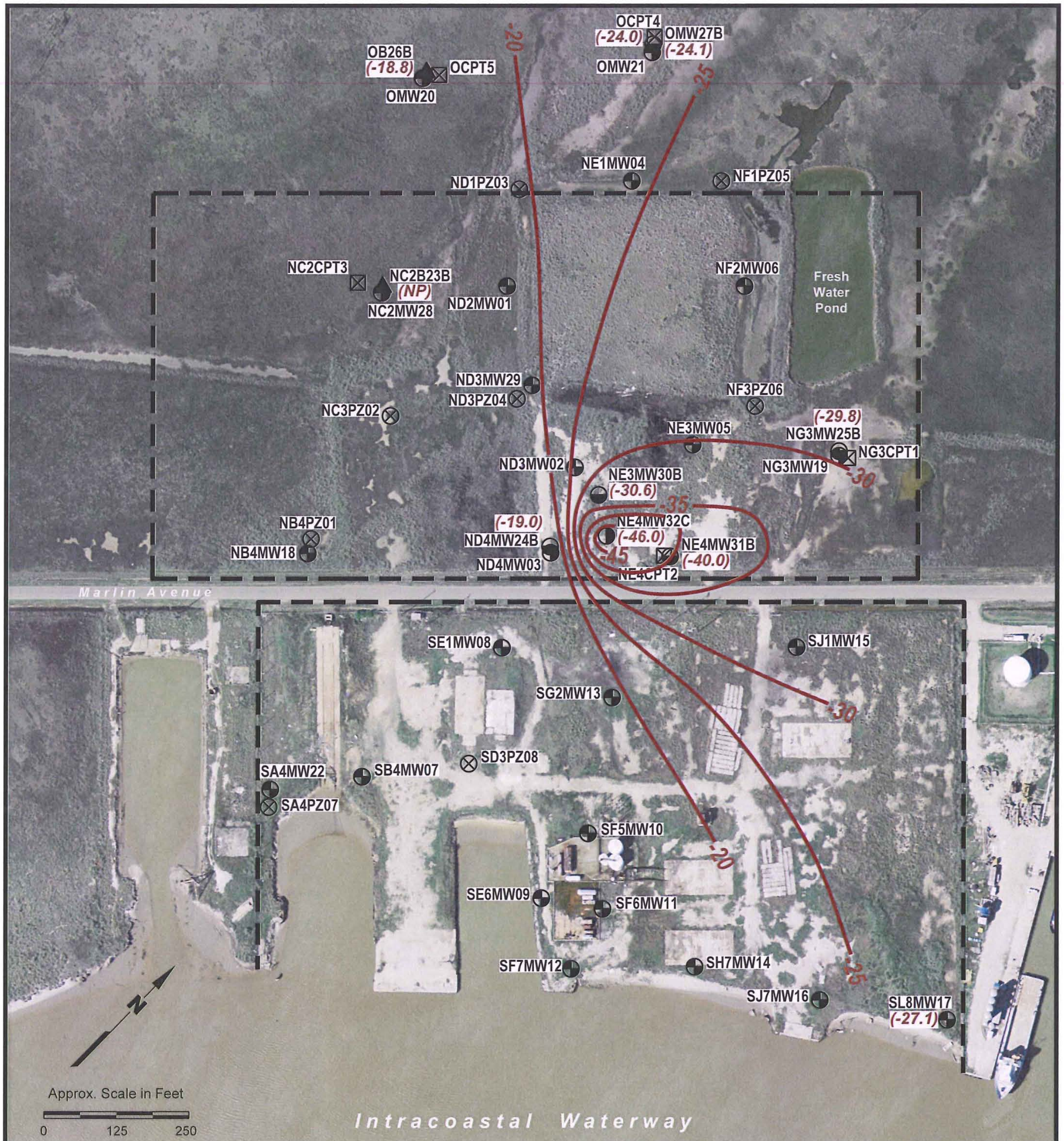
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 25

ZONE B THICKNESS MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location - Zone A
- Temporary Piezometer - Zone A
- Monitoring Well Location - Zone B
- Monitoring Well Location - Zone C
- CPT Piezometer Location - Zone C
- Soil Boring Location - Zone B
- (-19.0) Elevation of Base of Zone B (Ft MSL)
- (NP) Not Present
- -25 Base of Zone B Contour (Contour Interval = 5 Ft)

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 26

STRUCTURE CONTOUR MAP BASE OF ZONE B

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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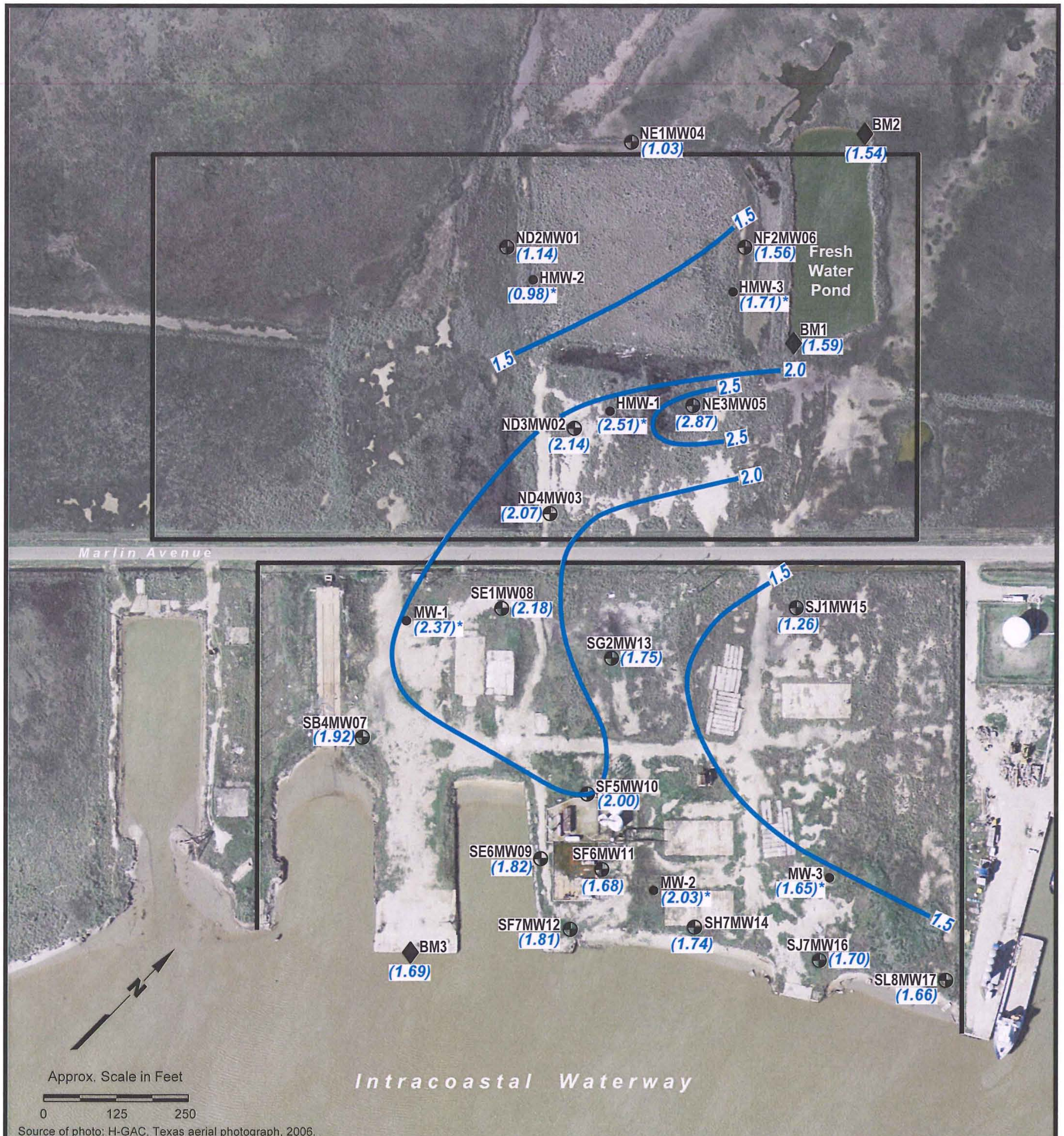

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location Zone A

Previous Monitoring Well Location

Staff Gauge

(1.69) Water-Level Elevation (Ft AMSL) Measured 10/05/06

* Elevation Not Used in Contouring

1.5 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.5 Ft

Note:
Previous monitoring well and staff gauge measurements included for reference only and not used to construct potentiometric surface contours.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 27

ZONE A POTENTIOMETRIC SURFACE OCTOBER 5, 2006

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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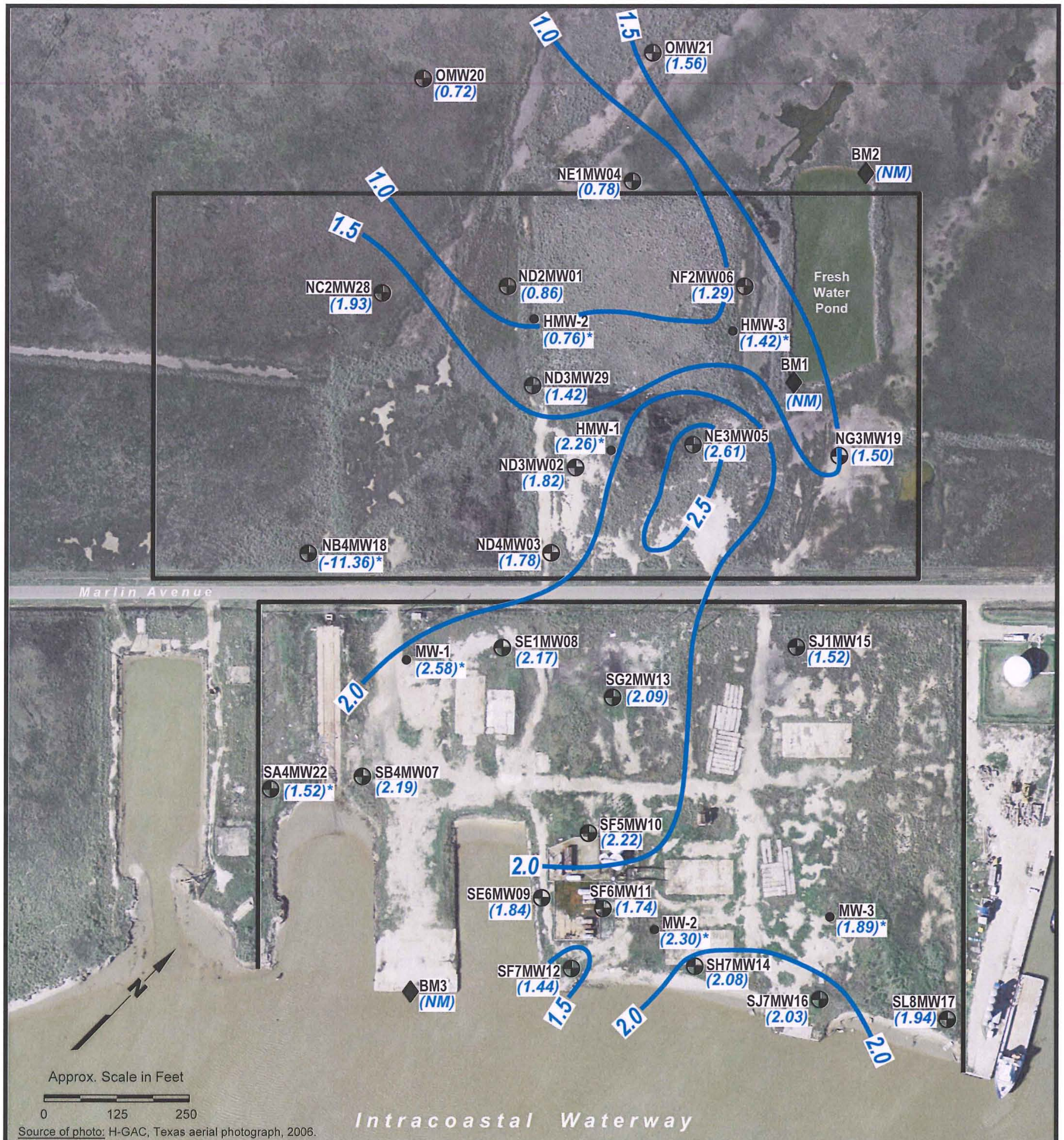

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)		(1.44)	Water-Level Elevation (Ft AMSL) Measured 06/06/07
Monitoring Well Location Zone A		(NM)	Not Measured
Previous Monitoring Well Location		*	Elevation Not Used in Contouring
Staff Gauge		1.5	Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.5 Ft

Notes:
Previous monitoring well measurements included for reference only and not used to construct potentiometric surface contours. Water-level elevation at NB4MW18 not used in contour due to insufficient recovery time from sampling. Staff gauge measurements not measured on this date.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 28

ZONE A POTENTIOMETRIC SURFACE JUNE 6, 2007

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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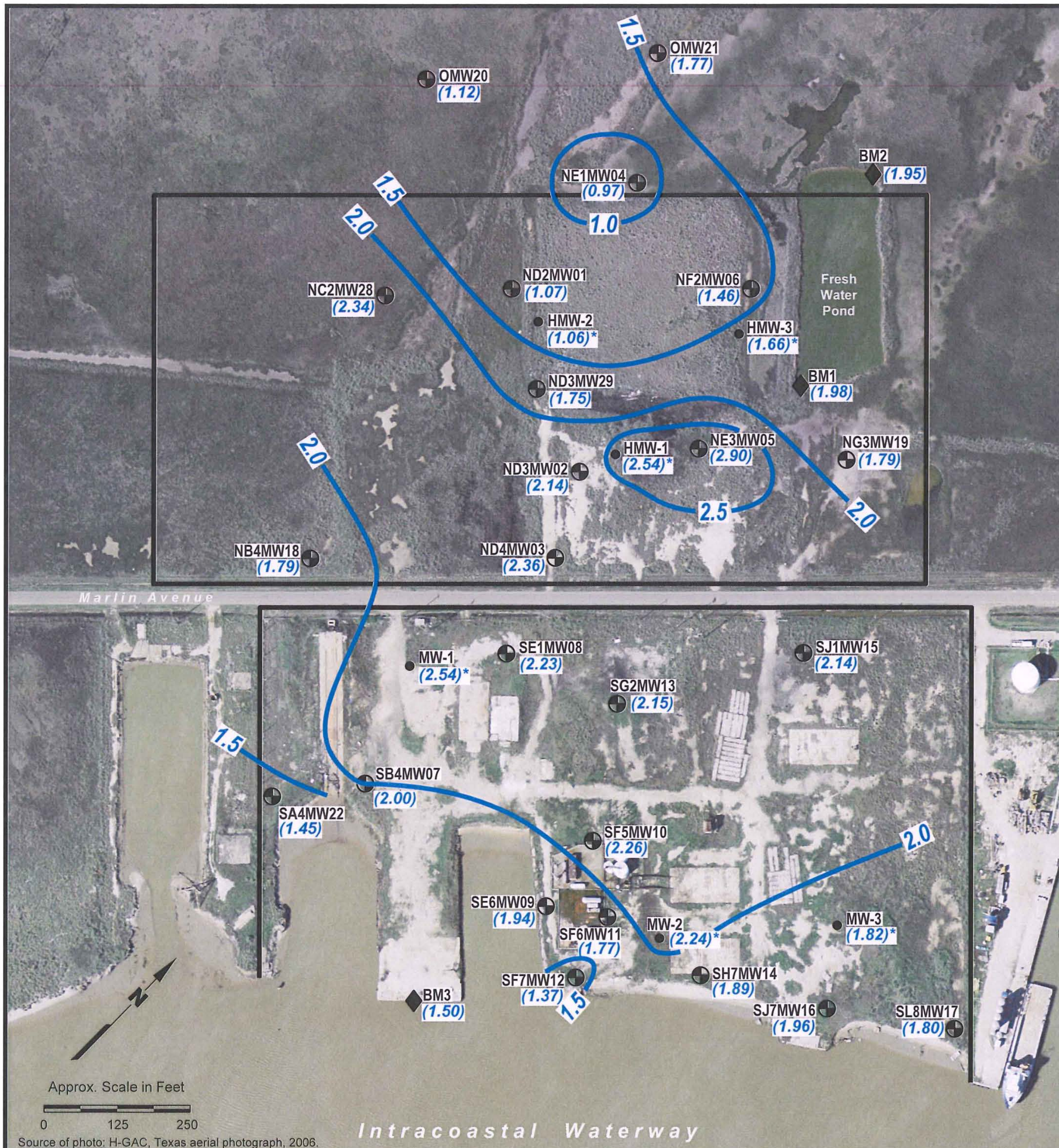

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location Zone A
- Previous Monitoring Well Location
- Staff Gauge
- (1.37) Water-Level Elevation (Ft AMSL) Measured 09/06/07
- * Elevation Not Used in Contouring
- 2.0 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.5 Ft

Note:
Previous monitoring well and staff gauge measurements included for reference only and not used to construct potentiometric surface contours.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 29

ZONE A POTENTIOMETRIC SURFACE SEPTEMBER 6, 2007

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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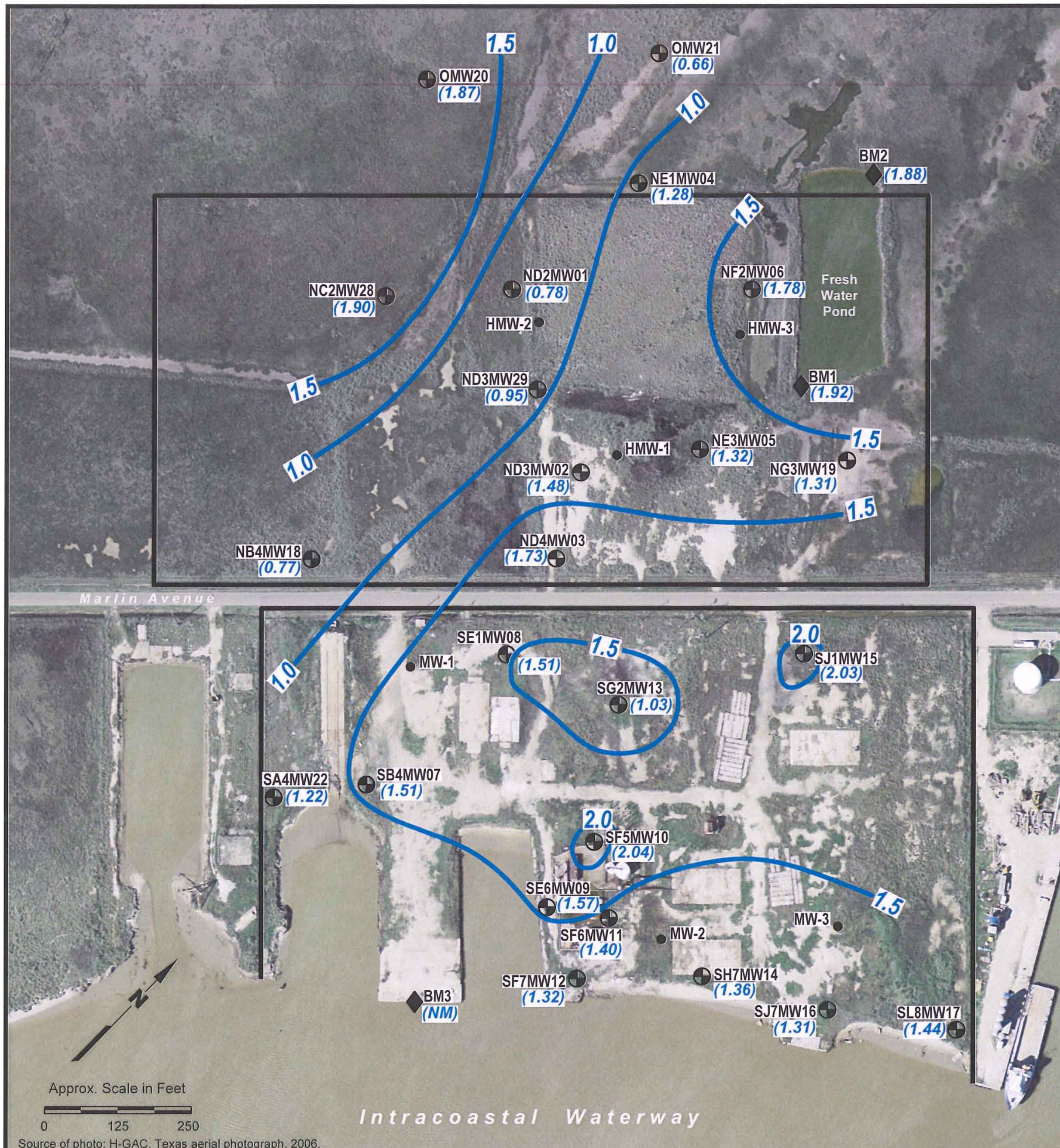

Source of photo: H-GAC, Texas aerial photograph, 2006.

EXPLANATION

Symbol	Description
(line)	Gulfco Marine Maintenance Site Boundary (approximate)
(1.32)	Water-Level Elevation (Ft AMSL) Measured 11/07/07
(well symbol)	Monitoring Well Location Zone A
(NM)	Not Measured
—1.5—	Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.5 Ft
(dot)	Previous Monitoring Well Location
(diamond)	Staff Gauge

Note:
Staff gauge measurements included for reference only and not used to construct potentiometric surface contours.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 30

ZONE A POTENTIOMETRIC SURFACE NOVEMBER 7, 2007

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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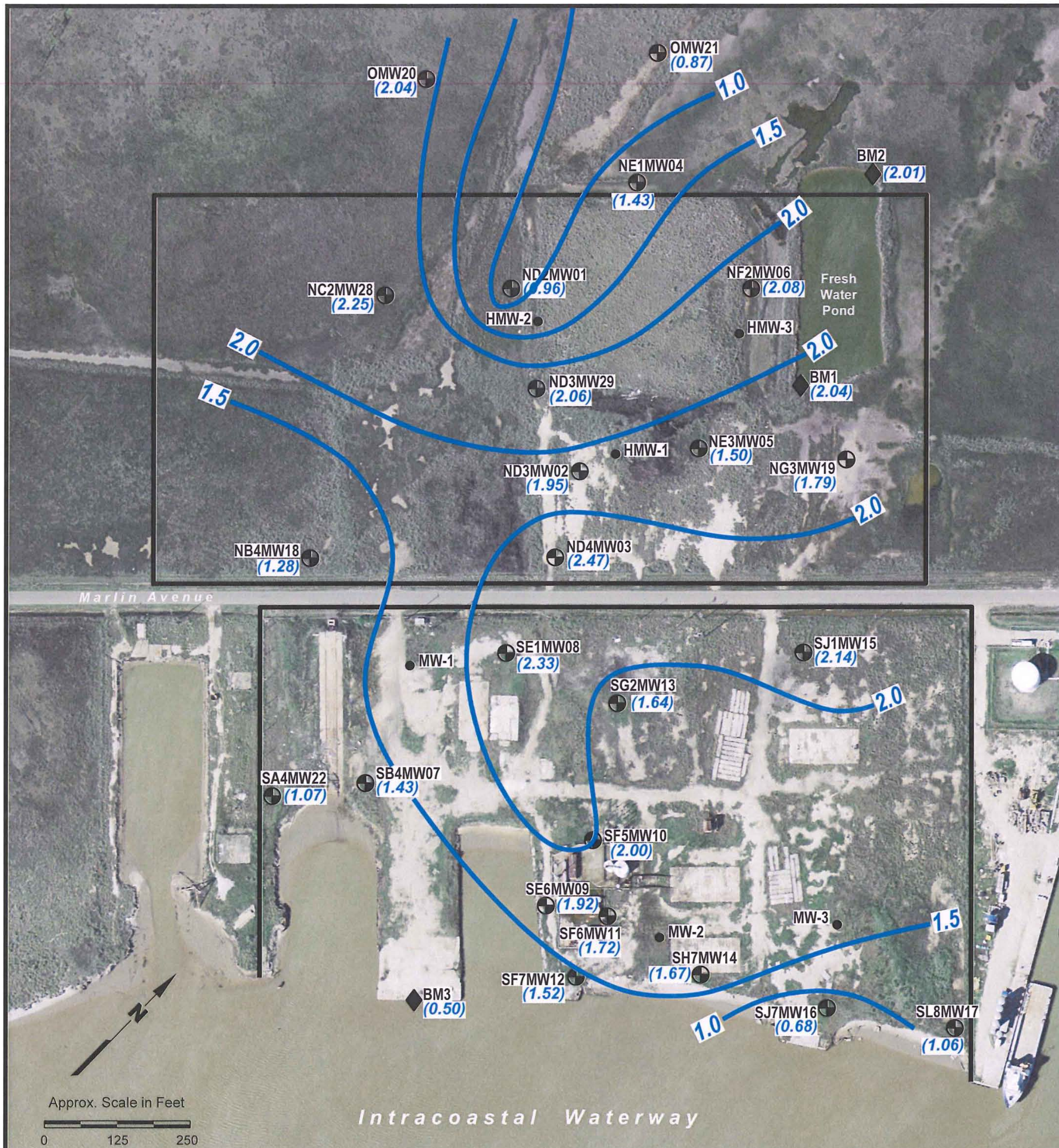


EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location Zone A

Previous Monitoring Well Location

Staff Gauge

(1.52) Water-Level Elevation (Ft AMSL) Measured 12/03/07

1.5 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.5 Ft

Note:
Staff gauge measurements included for reference only and not used to construct potentiometric surface contours.

Source of photo: H-GAC, Texas aerial photograph, 2006.

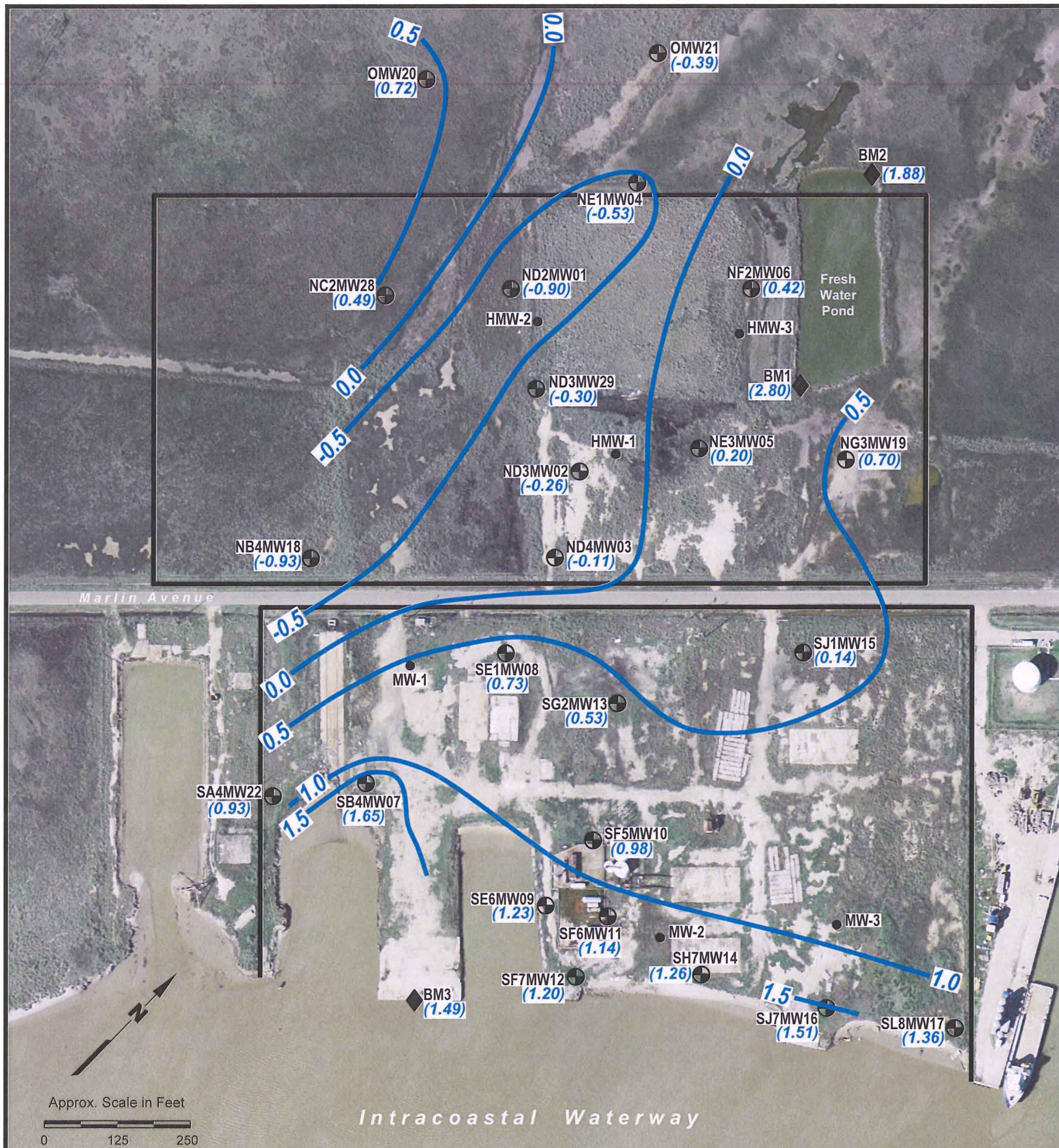
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 31

ZONE A POTENTIOMETRIC SURFACE DECEMBER 3, 2007

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location Zone A
- Previous Monitoring Well Location
- Staff Gauge
- (1.52) Water-Level Elevation (Ft AMSL) Measured 06/17/08
- 1.5 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.5 Ft

Note:
Staff gauge measurements included for reference only and not used to construct potentiometric surface contours.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 32

ZONE A POTENTIOMETRIC SURFACE JUNE 17, 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)	(1.89) Water-Level Elevation (Ft AMSL) Measured 06/06/07
Monitoring Well Location - Zone B	2.0 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.1 Ft

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 33

ZONE B POTENTIOMETRIC SURFACE JUNE 6, 2007

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone B

(2.29) Water-Level Elevation (Ft AMSL) Measured 09/06/07

2.0 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.1 Ft

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 34

ZONE B POTENTIOMETRIC SURFACE SEPTEMBER 6, 2007

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

▬	Gulfco Marine Maintenance Site Boundary (approximate)	(1.92)	Water-Level Elevation (Ft AMSL) Measured 11/07/07
◒	Monitoring Well Location - Zone B	—1.6—	Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.2 Ft

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 35

ZONE B POTENTIOMETRIC SURFACE NOVEMBER 7, 2007

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location - Zone B
- (2.38) Water-Level Elevation (Ft AMSL) Measured 12/03/07
- 2.0 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.2 Ft

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 36

ZONE B POTENTIOMETRIC SURFACE DECEMBER 3, 2007

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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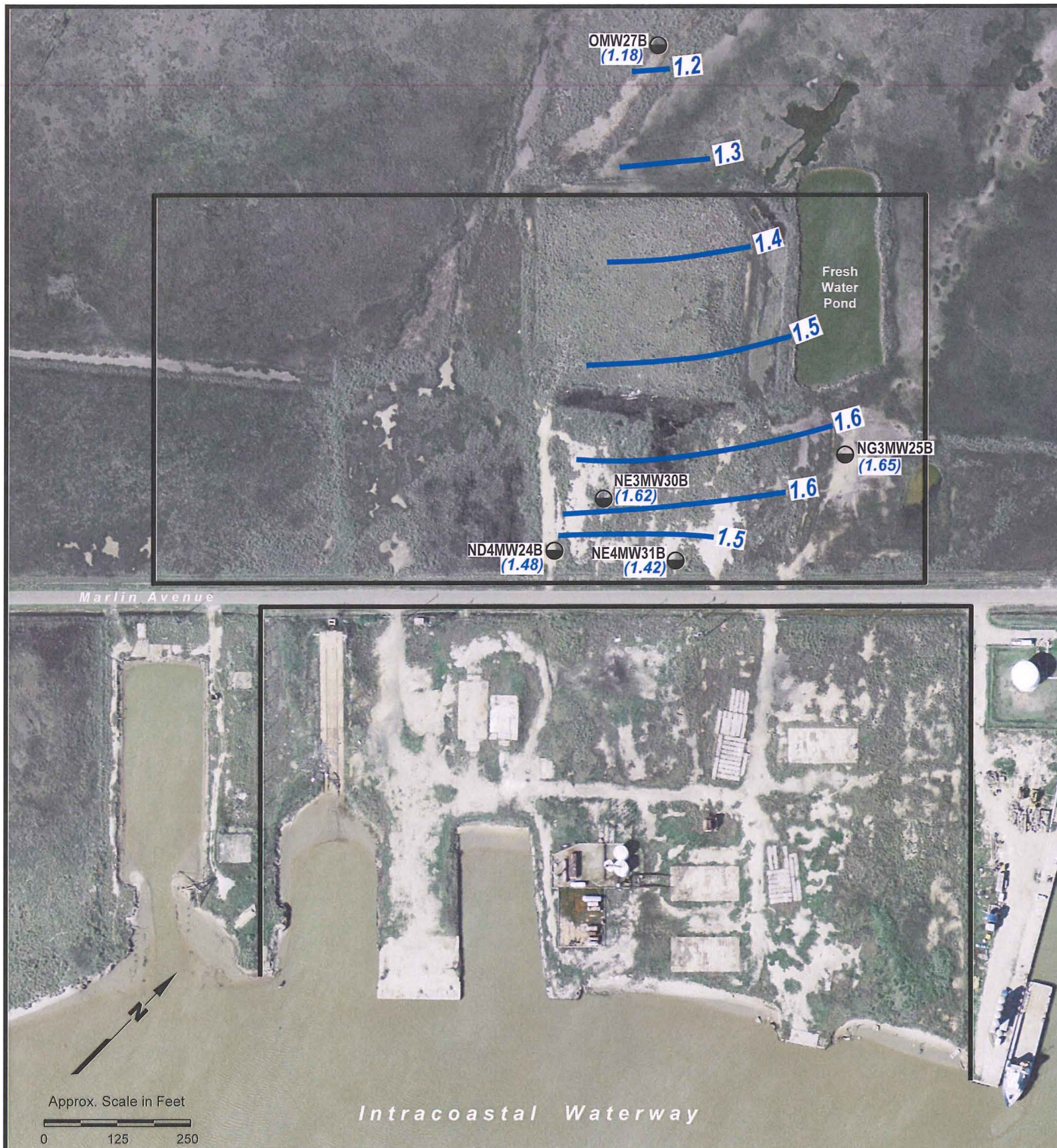

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 37

ZONE B POTENTIOMETRIC SURFACE JULY 30, 2008

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location - Zone B
- (1.48) Water-Level Elevation (Ft AMSL) Measured 7/30/08
- 1.5 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 0.1 Ft

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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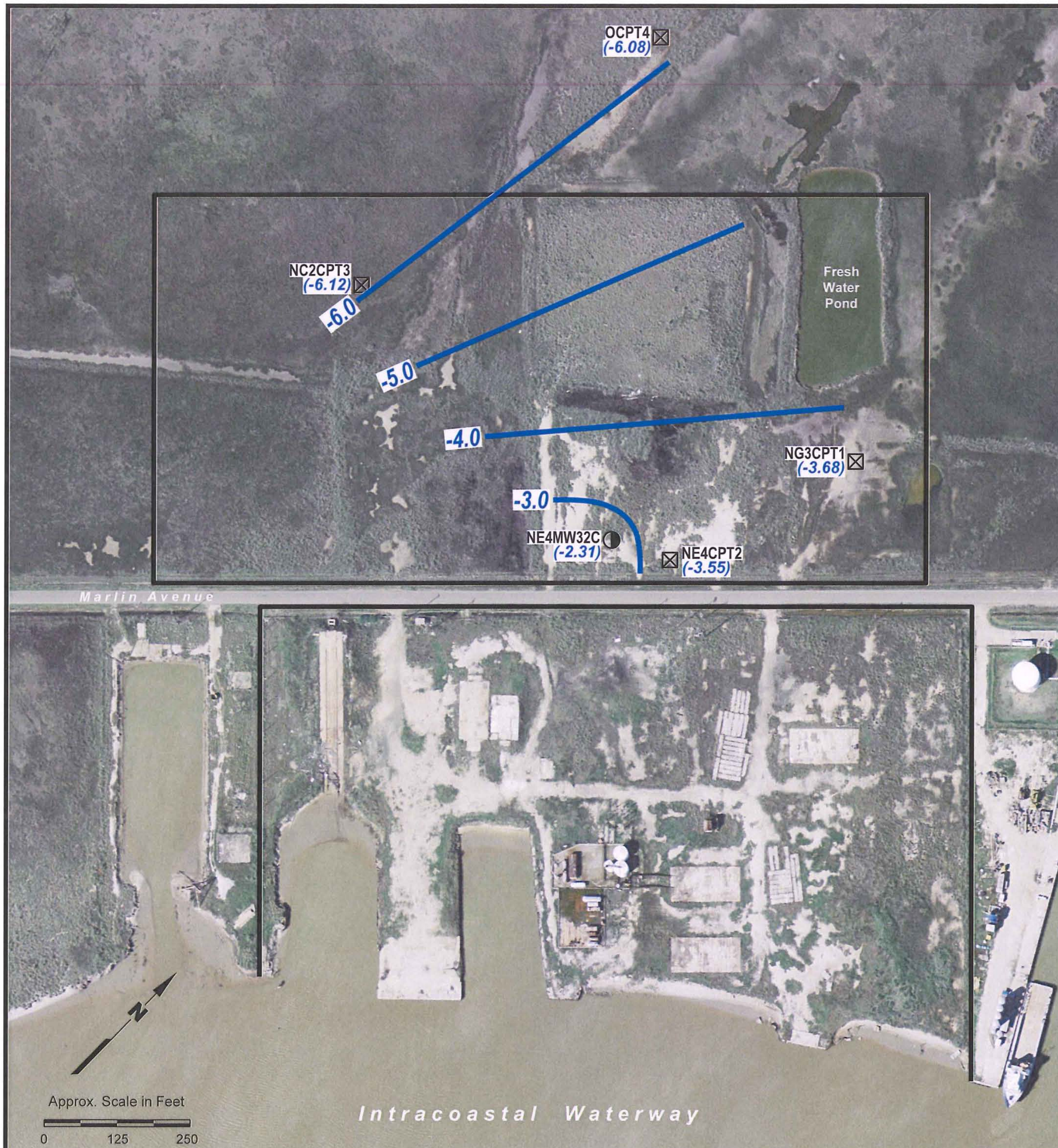
Source of photo: H-GAC, Texas aerial photograph, 2006.



EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location - Zone C
- CPT Piezometer Location - Zone C
- (-6.12) Water-Level Elevation (Ft AMSL) Measured 6/17/08
- -3.0 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 1 Ft

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 38

ZONE C POTENTIOMETRIC SURFACE JUNE 17, 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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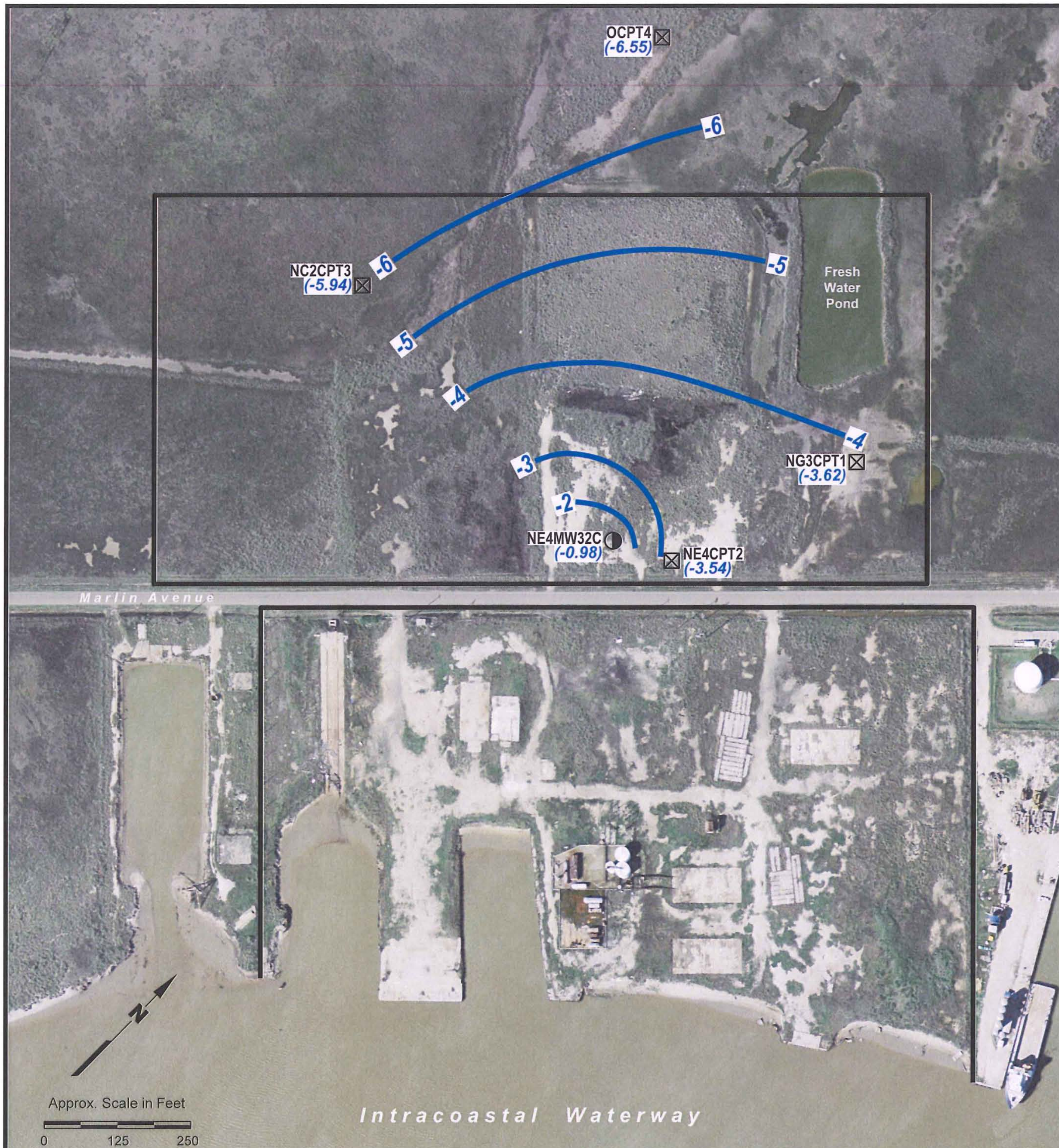

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 39

ZONE C POTENTIOMETRIC SURFACE JULY 30, 2008

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Monitoring Well Location - Zone C
- CPT Piezometer Location - Zone C
- (-6.55) Water-Level Elevation (Ft AMSL) Measured 7/30/08
- -3.0 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 1 Ft

Source of photo: H-GAC, Texas aerial photograph, 2006.

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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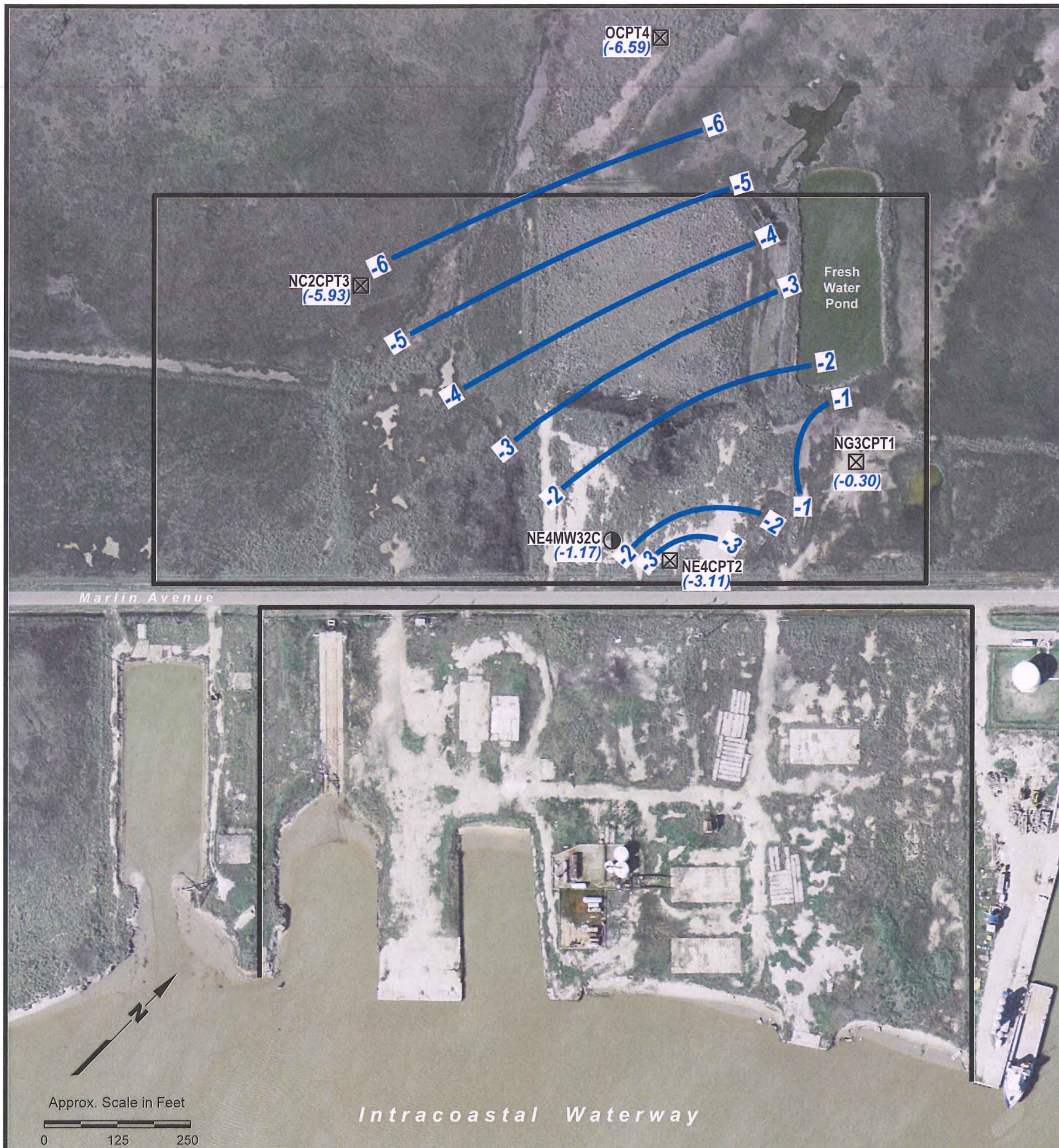

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone C

CPT Piezometer Location - Zone C

(-3.11) Water-Level Elevation (Ft AMSL) Measured 9/29/08

-3.0 Potentiometric Surface Contour (Ft AMSL) Contour Interval = 1 Ft

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 40

ZONE C
POTENTIOMETRIC SURFACE
SEPTEMBER 29, 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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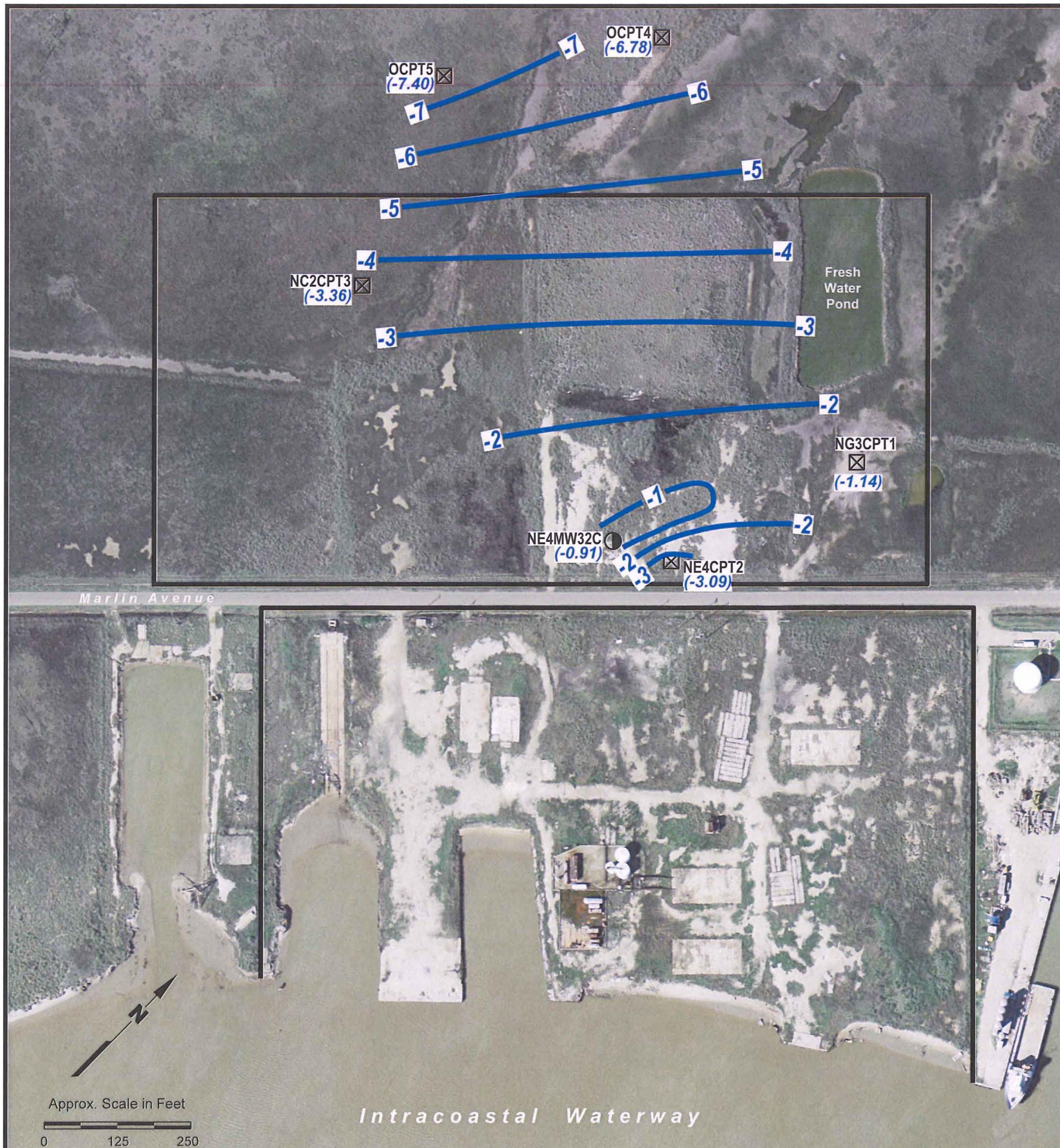

EXPLANATION

	Gulfco Marine Maintenance Site Boundary (approximate)	(-3.11)	Water-Level Elevation (Ft AMSL) Measured 1/13/09
◑	Monitoring Well Location - Zone C	-3.0	Potentiometric Surface Contour (Ft AMSL) Contour Interval = 1 Ft
⊠	CPT Piezometer Location - Zone C		

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 41

ZONE C
POTENTIOMETRIC SURFACE
JANUARY 13, 2009

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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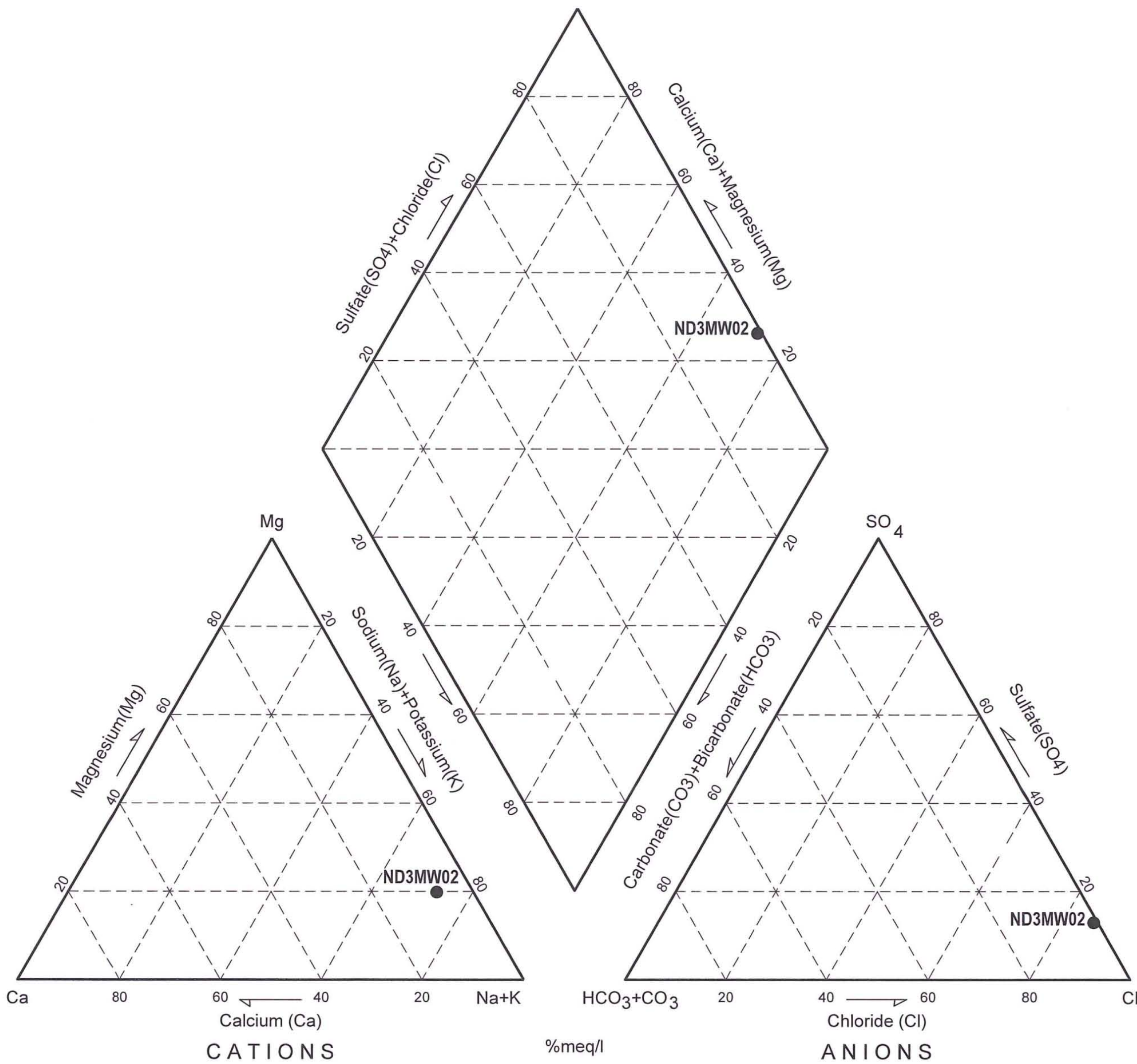

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 42

ZONE A TRILINEAR DIAGRAM

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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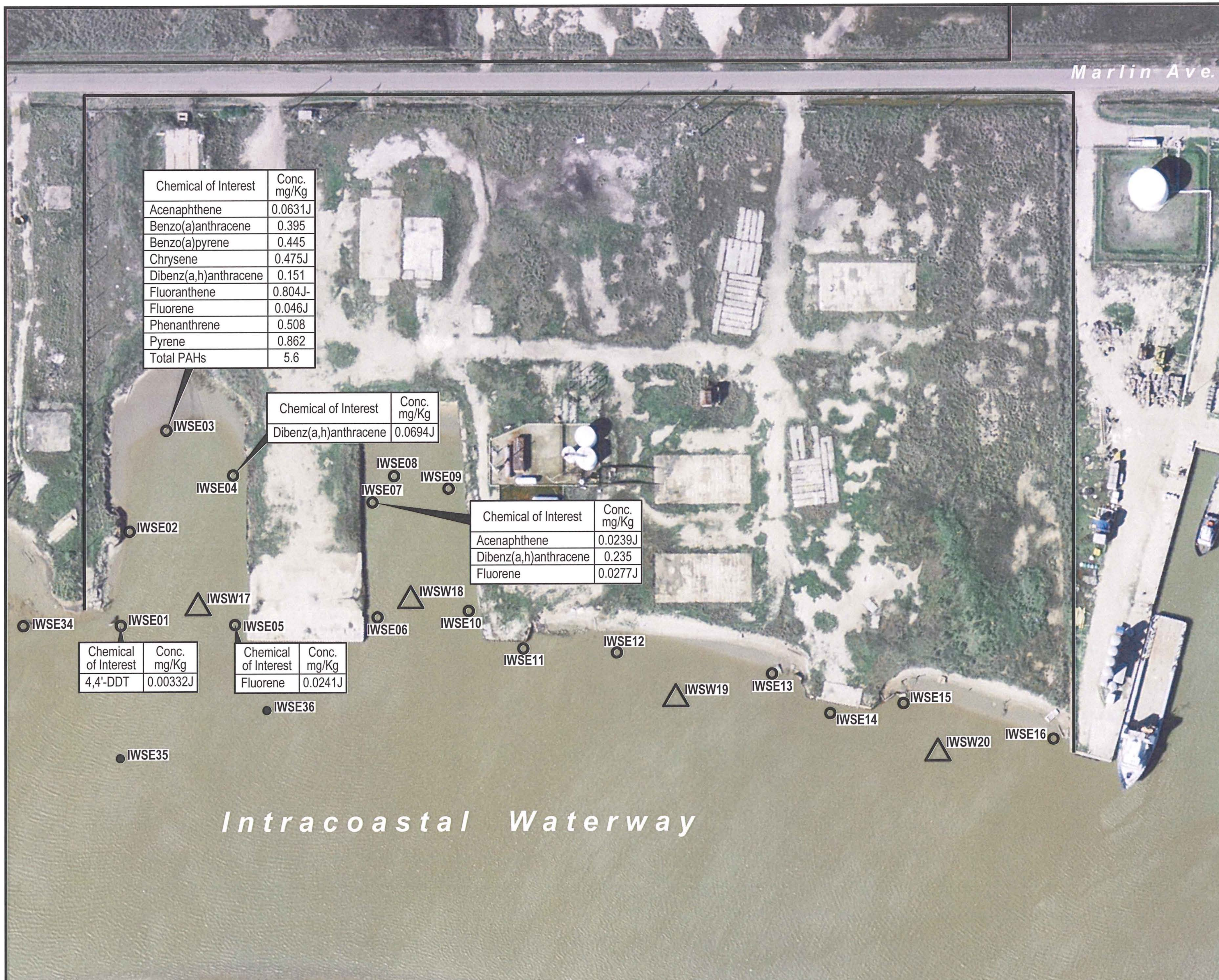

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Intracoastal Waterway Sediment Sample
- Intracoastal Waterway Surface Water Sample
- Attempted Intracoastal Waterway Sediment Sample

Notes:
1. Data Qualifiers: J = Estimated value. J- = Estimated value - biased low.
2. Total PAH concentrations were calculated using ½ of the sample detection limit as a proxy value for undetected PAHs.

N

Approx. Scale in Feet
0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 43

DETECTED CONCENTRATIONS EXCEEDING COMPARISON VALUES- INTRACOASTAL WATERWAY RI SEDIMENT SAMPLES

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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SA1SB15

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Benzo(a)anthracene	2.28J
0-0.5	Benzo(a)pyrene	3.6J
0-0.5	Benzo(b)fluoranthene	2.27J
0-0.5	Copper	105
0-0.5	Dibenz(a,h)anthracene	0.313
0-0.5	Indeno(1,2,3-cd)pyrene	1.39J
0-0.5	Lead	208
0-0.5	Zinc	877
1-2	Benzo(a)anthracene	4.21J
1-2	Benzo(a)pyrene	4.88J
1-2	Benzo(b)fluoranthene	5.34J
1-2	Copper	73.2
1-2	Dibenz(a,h)anthracene	0.817
1-2	Indeno(1,2,3-cd)pyrene	4.37J
1-2	Lead	395
1-2	Zinc	1090

SA2SB16

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Benzo(a)anthracene	1.29J
0-0.5	Benzo(a)pyrene	1.95J
0-0.5	Benzo(b)fluoranthene	2.05J
0-0.5	Chromium	40.6
0-0.5	Dibenz(a,h)anthracene	0.347
0-0.5	Indeno(1,2,3-cd)pyrene	1.44J
0-0.5	Lead	45.8
1-2	Aroclor-1254	3.42
1-2	Benzo(a)anthracene	1.71J
1-2	Benzo(a)pyrene	2.13J
1-2	Benzo(b)fluoranthene	2.76J
1-2	Chromium	45.6
1-2	Copper	128
1-2	Dibenz(a,h)anthracene	0.322
1-2	Indeno(1,2,3-cd)pyrene	1.31J
1-2	Lead	702
1-2	Molybdenum	10.4
1-2	Zinc	525

L20SB01

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Benzo(a)pyrene	0.283
1-2	Lead	19J

L20SB02

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Lead	19.7J

SA3SB17

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Benzo(a)anthracene	2.41J
0-0.5	Benzo(a)pyrene	3.41J
0-0.5	Benzo(b)fluoranthene	4.66J
0-0.5	Copper	207
0-0.5	Dibenz(a,h)anthracene	0.465
0-0.5	Indeno(1,2,3-cd)pyrene	1.47J
0-0.5	Molybdenum	2.24
0-0.5	Zinc	412
1-2	Aroclor-1254	11.5
1-2	Benzo(a)pyrene	0.608J
1-2	Benzo(b)fluoranthene	0.835J
1-2	Copper	487
1-2	Dibenz(a,h)anthracene	0.177
1-2	Lead	252
1-2	Mercury	0.85
1-2	Zinc	865

SB2SB22

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Aroclor-1254	2.84
1-2	Benzo(a)pyrene	0.38J

L20SB04

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Copper	73J
0-0.5	Lead	116J
0-0.5	Mercury	0.72
0-0.5	Zinc	453J

SB4SB24

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Aroclor-1254	2.73
1-2	Benzo(a)pyrene	1.37J
1-2	Dibenz(a,h)anthracene	0.324

L20SB05

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Benzo(a)pyrene	0.759
0-0.5	Lead	108J
0-0.5	Zinc	781J

SA4SB18

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Aroclor-1254	0.734J+
0-0.5	Barium	540J
0-0.5	Benzo(a)pyrene	0.329J
0-0.5	Lead	146J
0-0.5	Zinc	414

SA5SB19

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Aroclor-1254	0.457
0-0.5	Arsenic	11.5
0-0.5	Benzo(a)pyrene	0.371J
0-0.5	Lead	152J
0-0.5	Molybdenum	2.69J-
0-0.5	Zinc	412

L20SB07

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Aroclor-1254	1.02
0-0.5	Benzo(a)pyrene	0.776
0-0.5	Dibenz(a,h)anthracene	0.235
0-0.5	Lead	985J
0-0.5	Zinc	6510J

SA6SB20

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Dibenz(a,h)anthracene	0.132

L20SB06

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
0-0.5	Aroclor-1254	0.836
0-0.5	Benzo(a)pyrene	0.394
0-0.5	Lead	290J
0-0.5	Zinc	942J

SC3SB27

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Dibenz(a,h)anthracene	0.606

SC4SB28

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Benzo(a)pyrene	1.2J
1-2	Lead	192J

SD3SB33

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Benzo(a)pyrene	0.509J

SD5SB35

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Aroclor-1254	1.41
1-2	Benzo(a)anthracene	4.79
1-2	Benzo(a)pyrene	4.45J
1-2	Benzo(b)fluoranthene	5.97
1-2	Dibenz(a,h)anthracene	1.23
1-2	Indeno(1,2,3-cd)pyrene	2.79J
1-2	Mercury	0.5

SF2SB44

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Dibenz(a,h)anthracene	0.354J

SF3SB45

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Arsenic	9.58
1-2	Benzo(a)pyrene	0.966J

SF4SB46

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Benzo(a)pyrene	0.921J

SG4SB56

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Benzo(a)pyrene	0.248J

SG6SB59

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Benzo(a)pyrene	0.276J

SI1SB69

Depth (ft BGS)	Chemical of Interest	Conc. (mg/Kg)
1-2	Arsenic	9.38

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Shallow Soil Sample (0-2 ft)

Shallow (0-2 ft) and Deep (4-5 ft) Soil Sample

Lot 20 Soil Sample

Note:
Data Qualifiers: J = Estimated value.
J- = Estimated value - biased low.
J+ = Estimated value - biased high.

N

Approx. Scale in Feet

0 125

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 44

DETECTED CONCENTRATIONS EXCEEDING COMPARISON VALUES- SOUTH AREA PHASE 1 PERIMETER RI SOIL SAMPLES

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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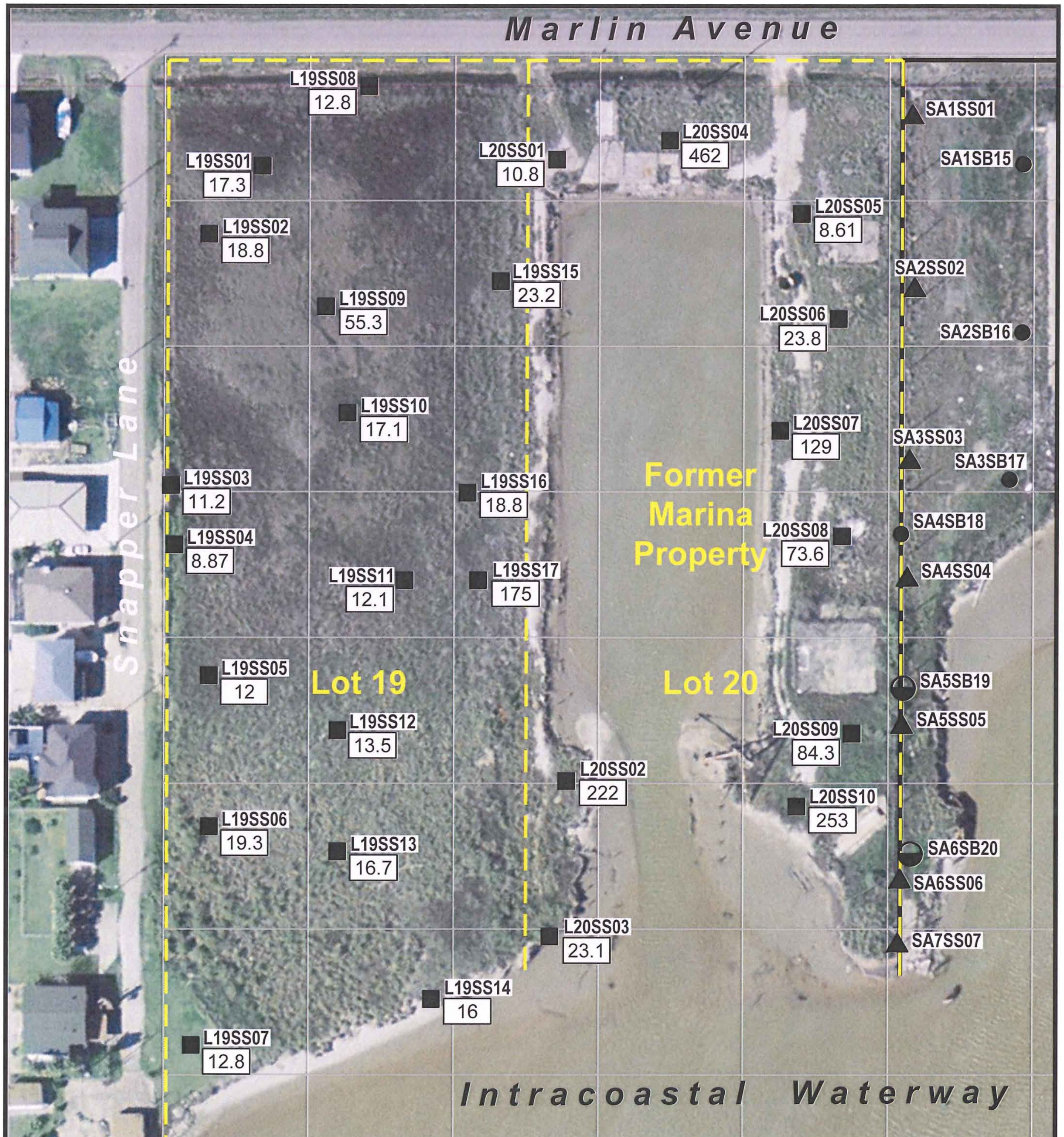

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Parcel Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Lot 21 Surface Soil Sample (0-1 in)
- Lot 19/20 Surface Soil Sample (0-1 in)
- 12.8 Lead Concentration (mg/Kg)

N

Approx. Scale in Feet

0 50 100

Source of photo:
H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 45

LEAD CONCENTRATIONS IN LOT 19-20 SURFACE SOIL SAMPLES

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Shallow (0-2 ft) Soil Sample
- Shallow (0-2 ft) and Deep (4+ ft) Soil Sample
- Geotechnical Soil Boring

Notes:
1. Data Qualifiers: J = Estimated value. J- = Estimated value, biased low.
2. BGS = below ground surface.

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 46

DETECTED CONCENTRATIONS EXCEEDING VERTICAL COMPARISON VALUES - NORTH AREA RI SOIL SAMPLES

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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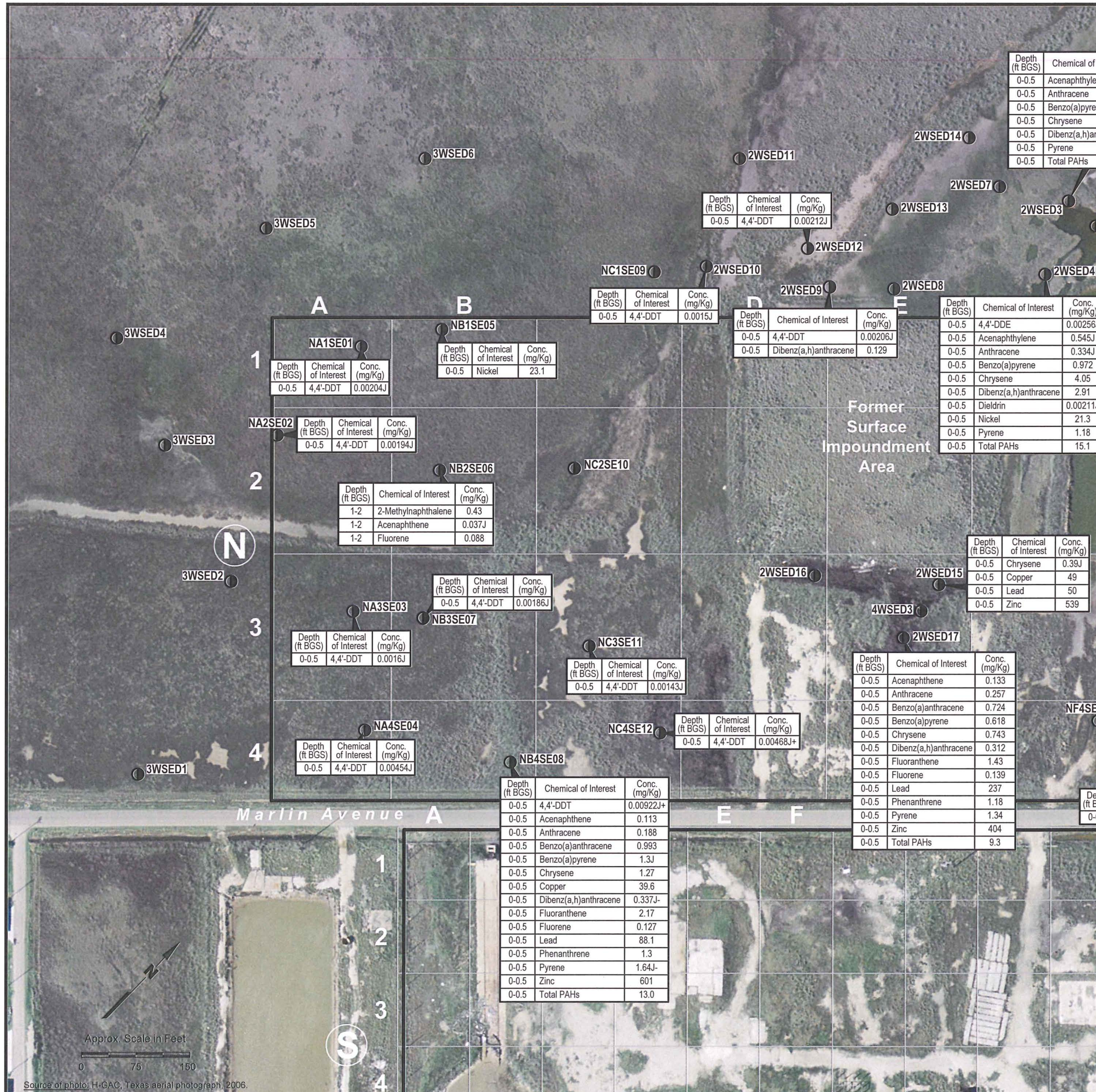

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Sediment Sample Location

Notes:
1. Data Qualifiers: J = Estimated value.
   J- = Estimated value, biased low.
   J+ = Estimated value, biased high.
2. BGS = below ground surface.
3. Total PAH concentrations were calculated using ½ of the sample detection limit as a proxy value for undetected PAHs.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 47

DETECTED CONCENTRATIONS EXCEEDING COMPARISON VALUES -RI WETLAND SEDIMENT SAMPLES

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Wetland Surface Water Sample Location

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 48

DETECTED CONCENTRATIONS EXCEEDING COMPARISON VALUES - RI WETLAND SURFACE WATER SAMPLES

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Pond Sediment Sample Location

Notes:
1. All samples from 0-0.5 ft depth interval.
2. Data Qualifier: J = Estimated value.

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 49

DETECTED CONCENTRATIONS EXCEEDING COMPARISON VALUES - RI POND SEDIMENT SAMPLES

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

△ Pond Surface Water Sample Location

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet
0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 50

DETECTED CONCENTRATIONS EXCEEDING COMPARISON VALUES - RI POND SURFACE WATER SAMPLES

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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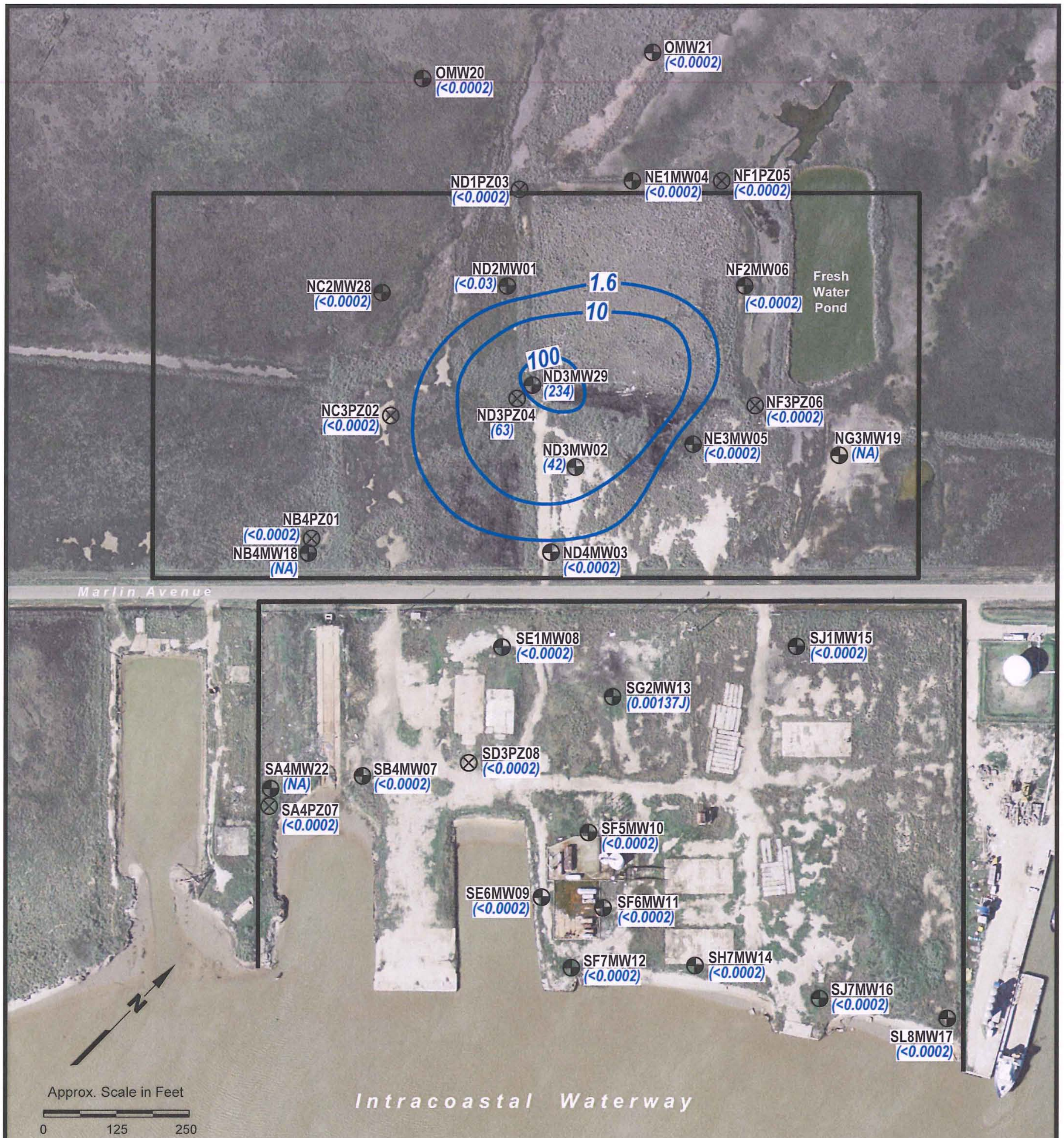
076903



EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(<0.03) 1,1,1-Trichloroethane (1,1,1-TCA) Concentration (mg/L)

10 Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are for the most recent sample collected from each location.
2. NA = Not analyzed for this compound.
3. J = Estimated value.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 51

1,1,1-TCA CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(2.35) 1,1-Dichloroethene (1,1-DCE) Concentration (mg/L)

0.7 Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are for the most recent sample collected from each location.
2. NA = Not analyzed for this compound.
3. J = Estimated value.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 52

1,1-DCE CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(3.86J) 1,2,3-Trichloropropane (1,2,3-TCP) Concentration (mg/L)

10 Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are for the most recent sample collected from each location.
2. NA = Not analyzed for this compound.
3. J = Estimated value.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 53

1,2,3-TCP CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(1.25) 1,2-Dichloroethane (1,2-DCA) Concentration (mg/L)

0.5 Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are from the most recent sample collected from each location.
2. NA = Not analyzed for this compound.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 54

1,2-DCA CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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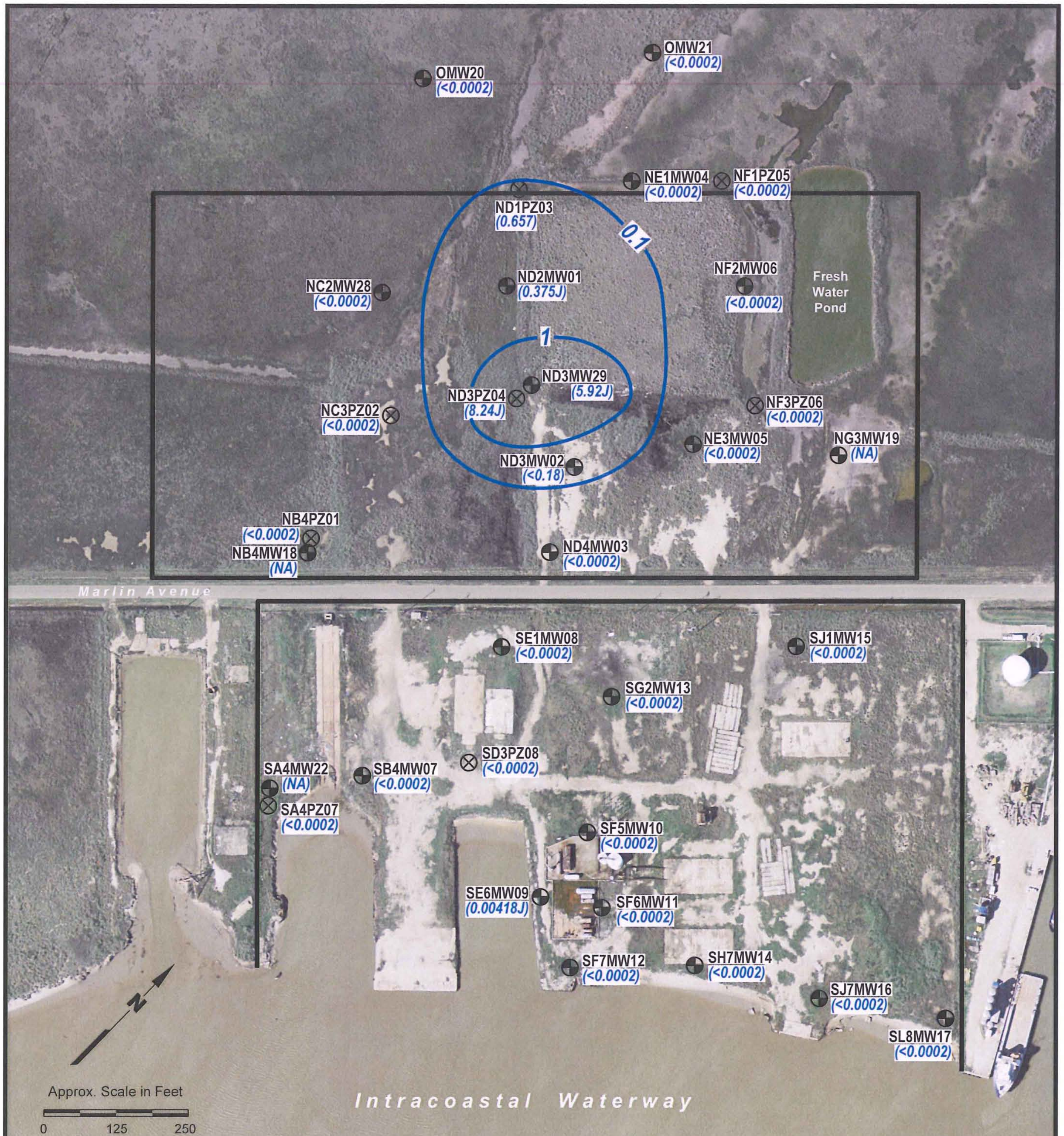

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(1.25) Benzene Concentration (mg/L)

0.1 Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are for the most recent sample collected from each location.
2. NA = Not analyzed for this compound.
3. J = Estimated value.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 55

BENZENE CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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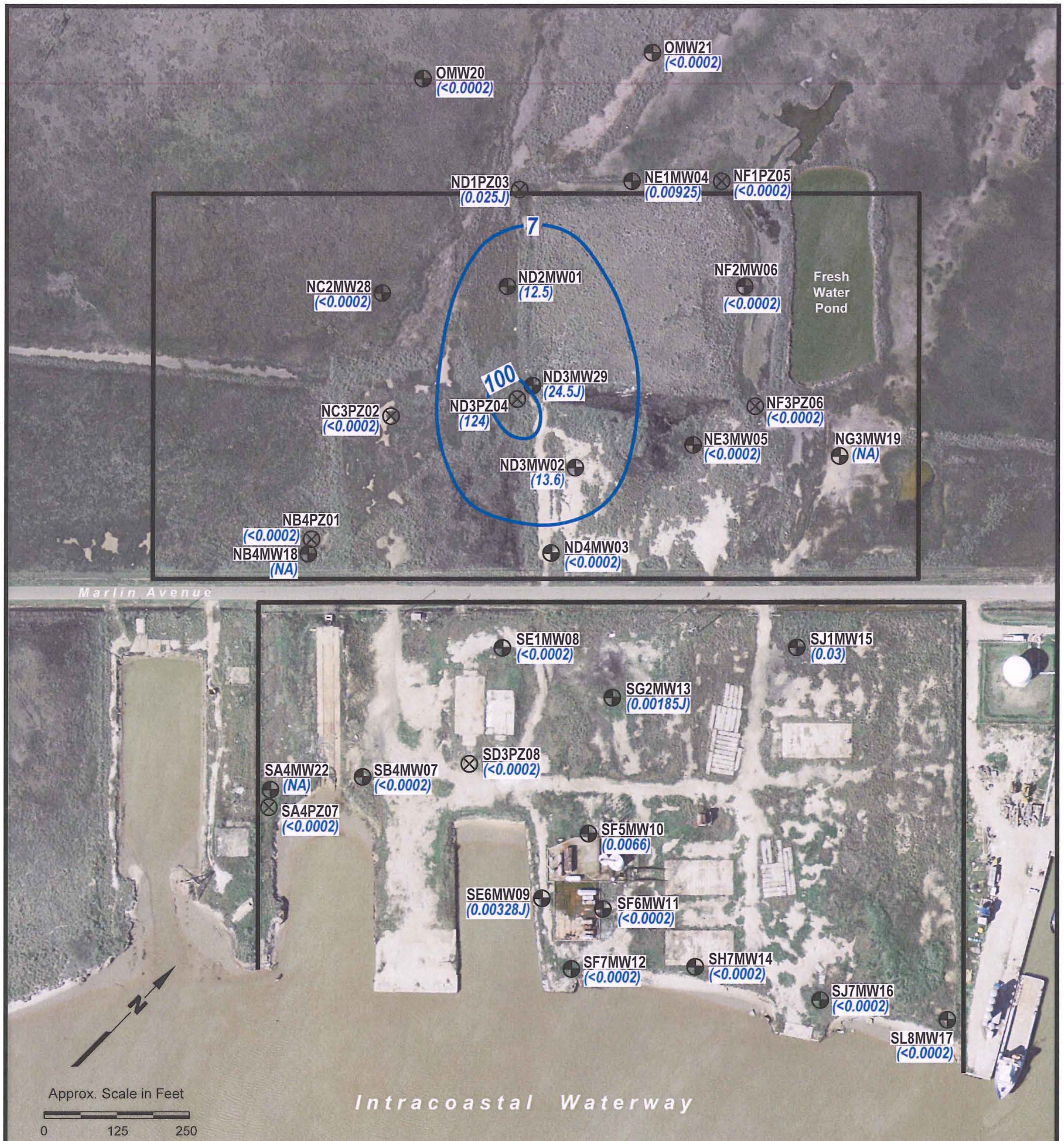

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(12.5) Cis-1,2-Dichloroethene (cis-1,2-DCE) Concentration (mg/L)

—7— Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are for the most recent sample collected from each location.
2. NA = Not analyzed for this compound.
3. J = Estimated value.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 56

CIS-1,2-DCE CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(<0.1) Methylene Chloride Concentration (mg/L)

0.5 Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are for the most recent sample collected from each location.
2. NA = Not analyzed for this compound.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 57

METHYLENE CHLORIDE CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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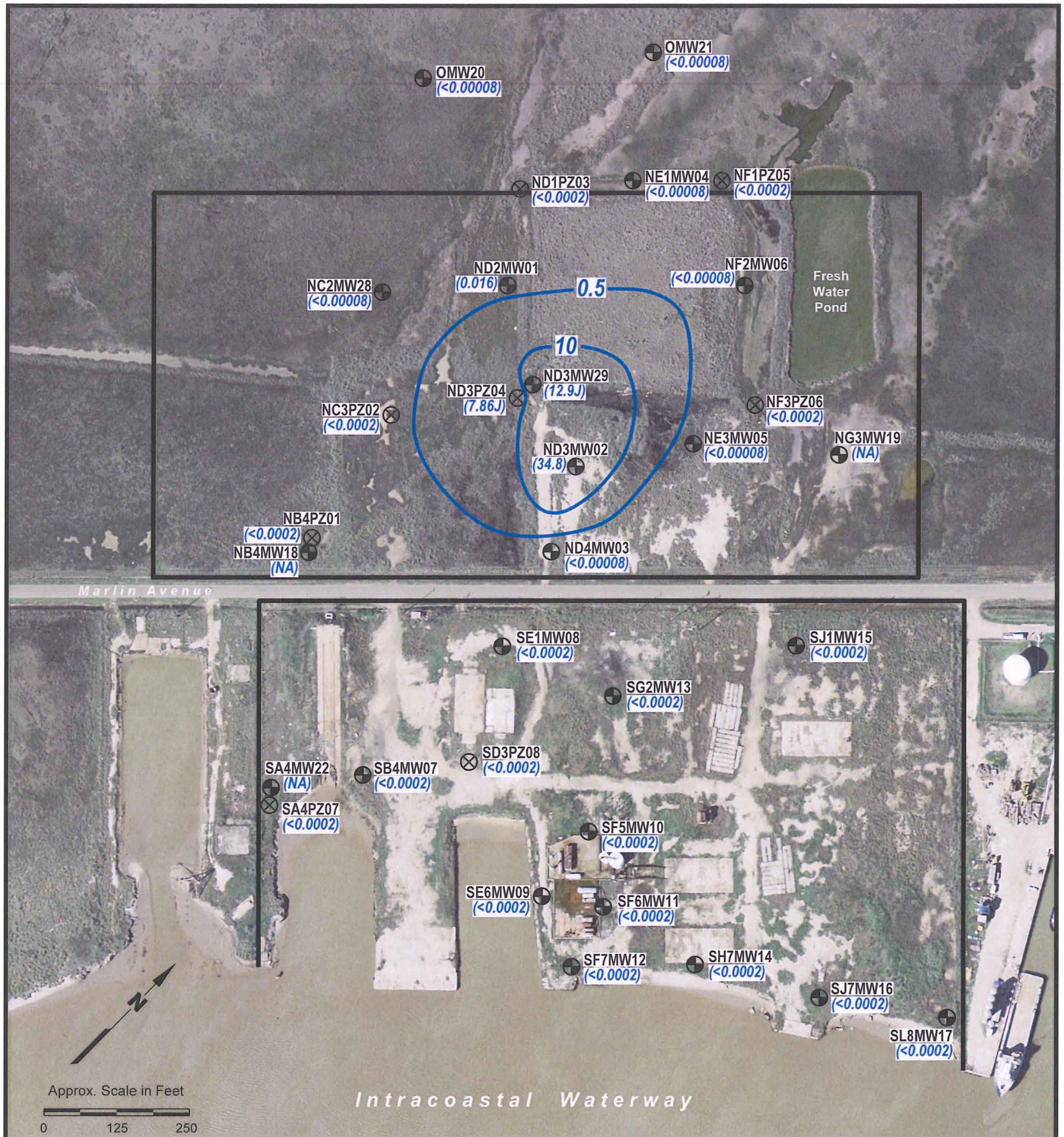
076910



EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(7.86J) Tetrachloroethene (PCE) Concentration (mg/L)

0.5 Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are for the most recent sample collected from each location.
2. NA = Not analyzed for this compound.
3. J = Estimated value.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 58

PCE CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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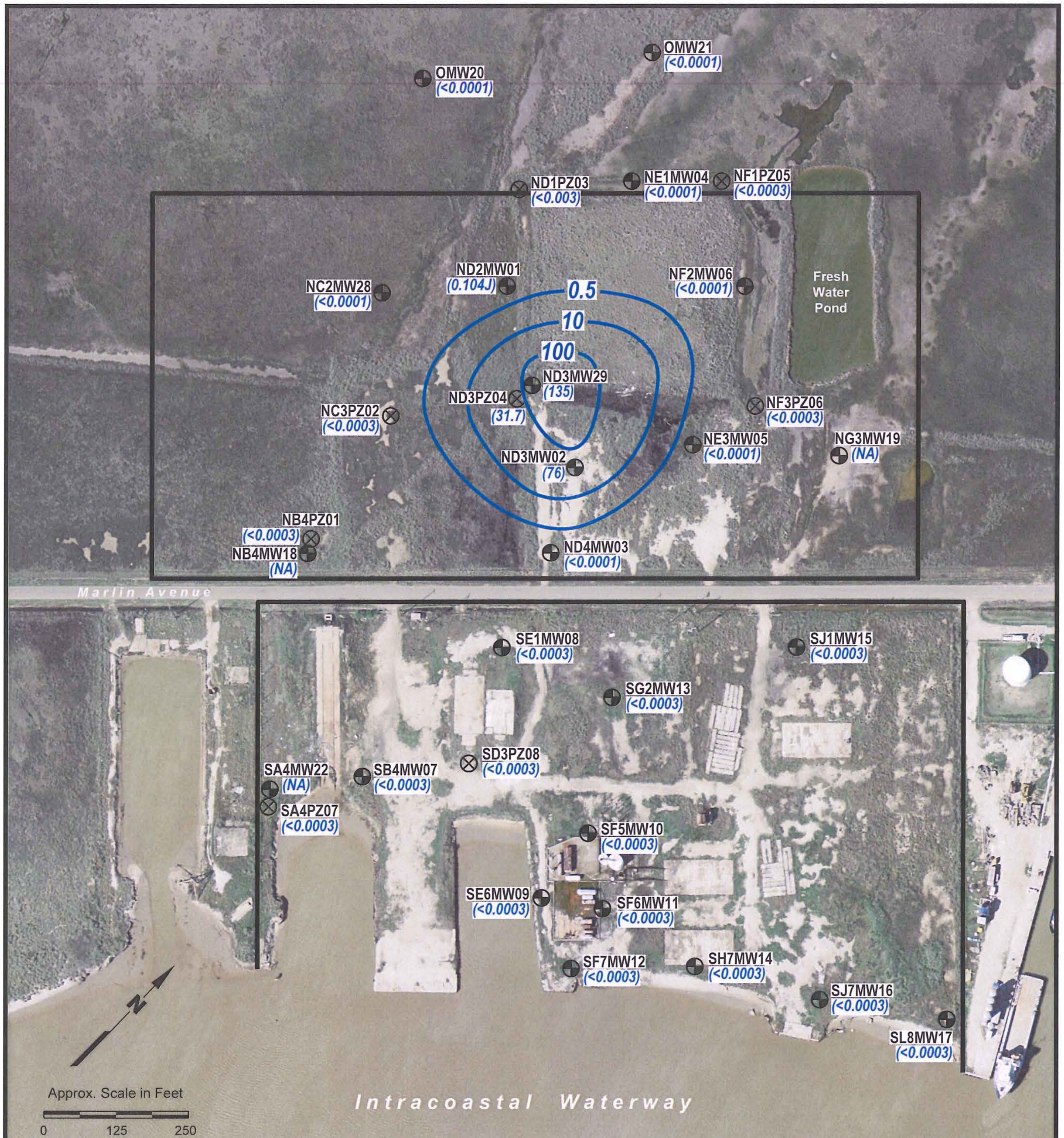

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(31.7) Trichloroethene (TCE) Concentration (mg/L)

0.5 Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are for the most recent sample collected from each location.
2. NA = Not analyzed for this compound.
3. J = Estimated value.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 59

TCE CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(1.22) Vinyl Chloride Concentration (mg/L)

0.2 Concentration Contour (mg/L) Variable Contour Interval

Notes:
1. Concentrations are for the most recent sample collected from each location.
2. NA = Not analyzed for this compound.
3. J = Estimated value.

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 60

VINYL CHLORIDE CONCENTRATIONS IN ZONE A MONITORING WELLS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

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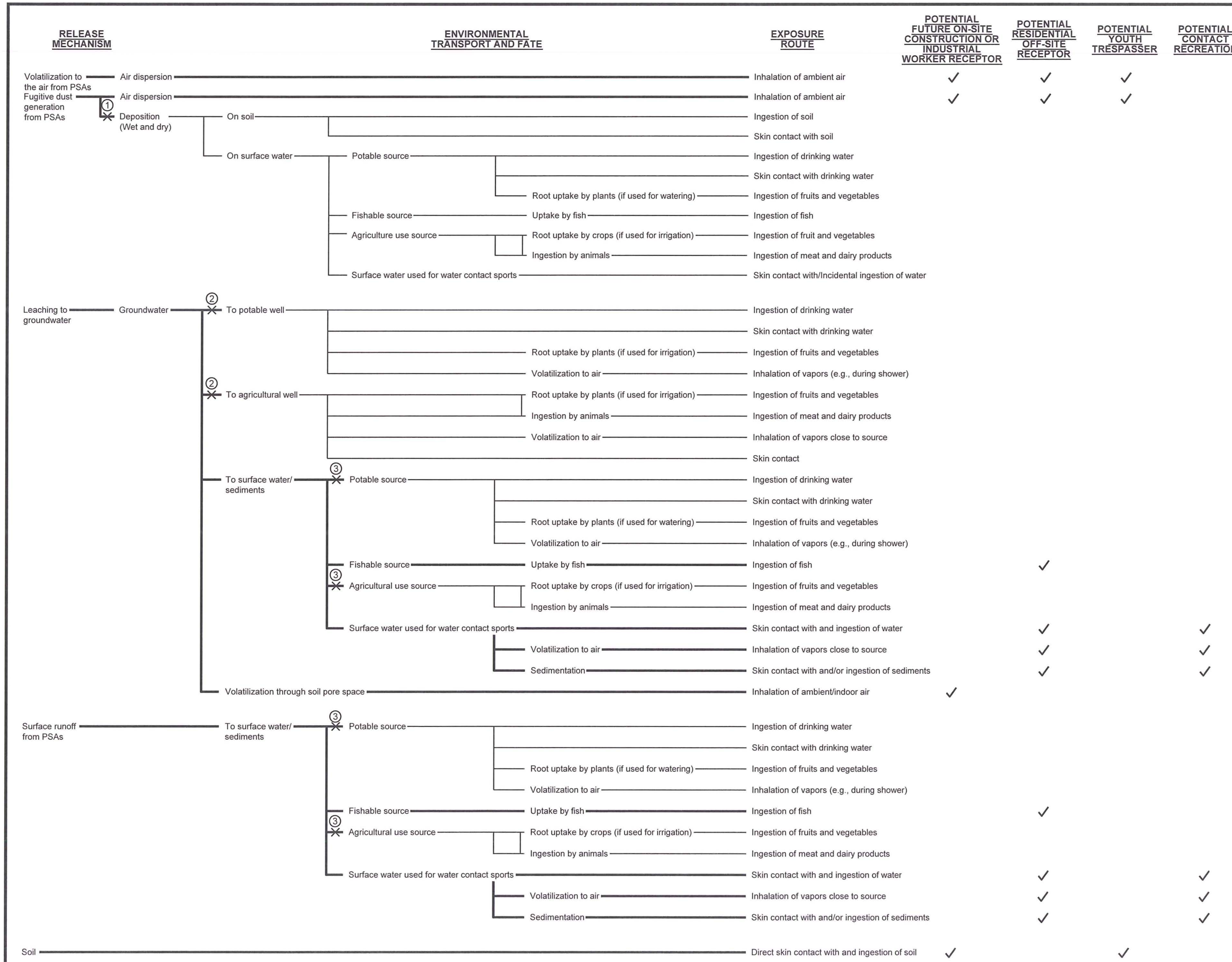
076913



LEGEND:

—X— Pathway is Incomplete

—— Pathway is Complete, Significance evaluated in Baseline Human Health Risk Assessment (BHHRA)

NOTES:

1. Based on surface soil samples collected on Lots 19 and 20, it does not appear that significant entrainment and subsequent deposition of particulates has occurred at the Site or at off-site locations.
2. No water supply or agricultural wells are in use in the Site vicinity and groundwater in the uppermost water-bearing units is not usable due to high total dissolved solids concentrations. The incompleteness of this pathway is contingent on the continued stability of the groundwater contaminant plume within the uppermost, non-potable water-bearing units at the Site.
3. Surface water is not a potable or agricultural source due to high salinity.

✓ Indicates potential receptor for complete migration pathway.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 61

HUMAN HEALTH CONCEPTUAL SITE MODEL SOUTH AREA

PROJECT: 1352	BY: ZGK	REVISIONS:
DATE: APRIL, 2011	CHECKED: KHT	

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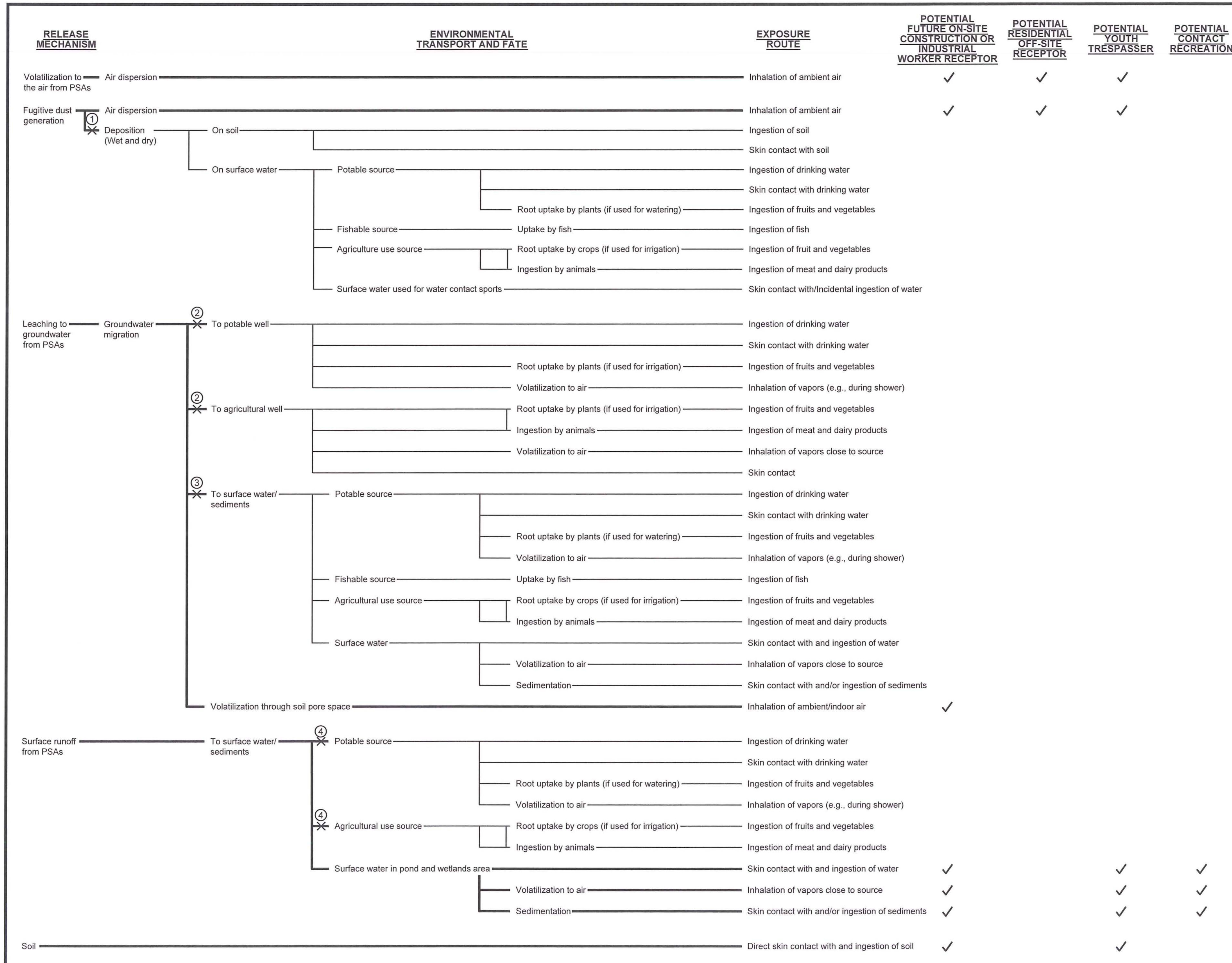

LEGEND:

Pathway is Incomplete

Pathway is Complete, Significance evaluated in Baseline Human Health Risk Assessment (BHHRA)

NOTES:

1. The high moisture content and vegetated nature of the limited surface soils in the North Area are not conducive to significant dust generation, dispersion and subsequent deposition.
2. No water supply or agricultural wells are in use in the Site vicinity and groundwater in the uppermost water-bearing units is not usable due to high total dissolved solids concentrations. The determination of this pathway as incomplete is contingent on the continued stability of the groundwater contaminant plume within the uppermost, non-potable water-bearing units at the Site.
3. Groundwater communication with North Area surface water features (e.g., ponds, wetlands) is not significant due to water table elevations below the shallow depths of these features and the low permeability of underlying clay soils.
4. Nearby surface water is not used for agricultural use or drinking water.

✓ Indicates potential receptor for complete migration pathway.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 62

HUMAN HEALTH CONCEPTUAL SITE MODEL NORTH AREA

PROJECT: 1352	BY: ZGK	REVISIONS:
DATE: APRIL, 2011	CHECKED: KHT	

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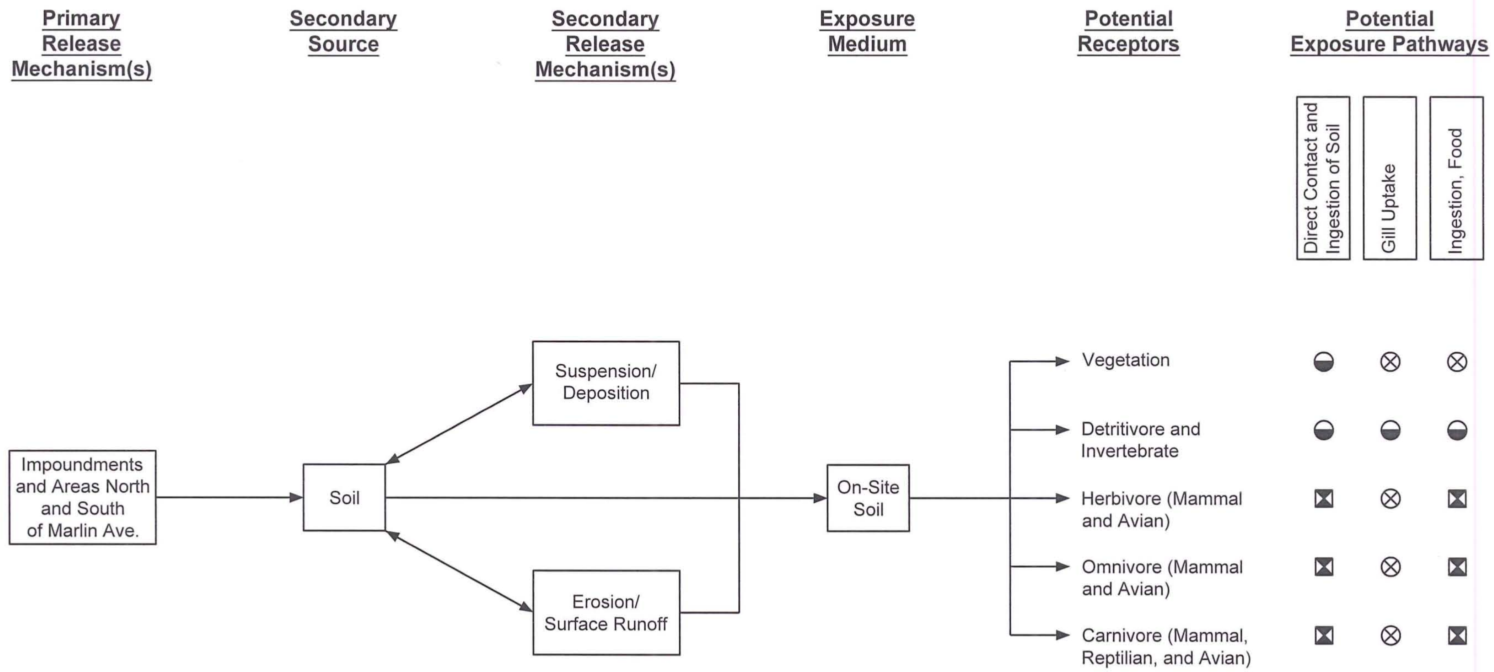

LEGEND

- No acceptable risk (Final SLERA conclusion)
- Pathway is potentially complete
- Pathway is incomplete
- Pathway is not viable
- For South Area soils, pathway is mitigated by lack of complete exposure pathways. For North Area soils, pathway is potentially complete.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 63

CONCEPTUAL SITE MODEL -TERRESTRIAL ECOSYSTEM

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: KHT	

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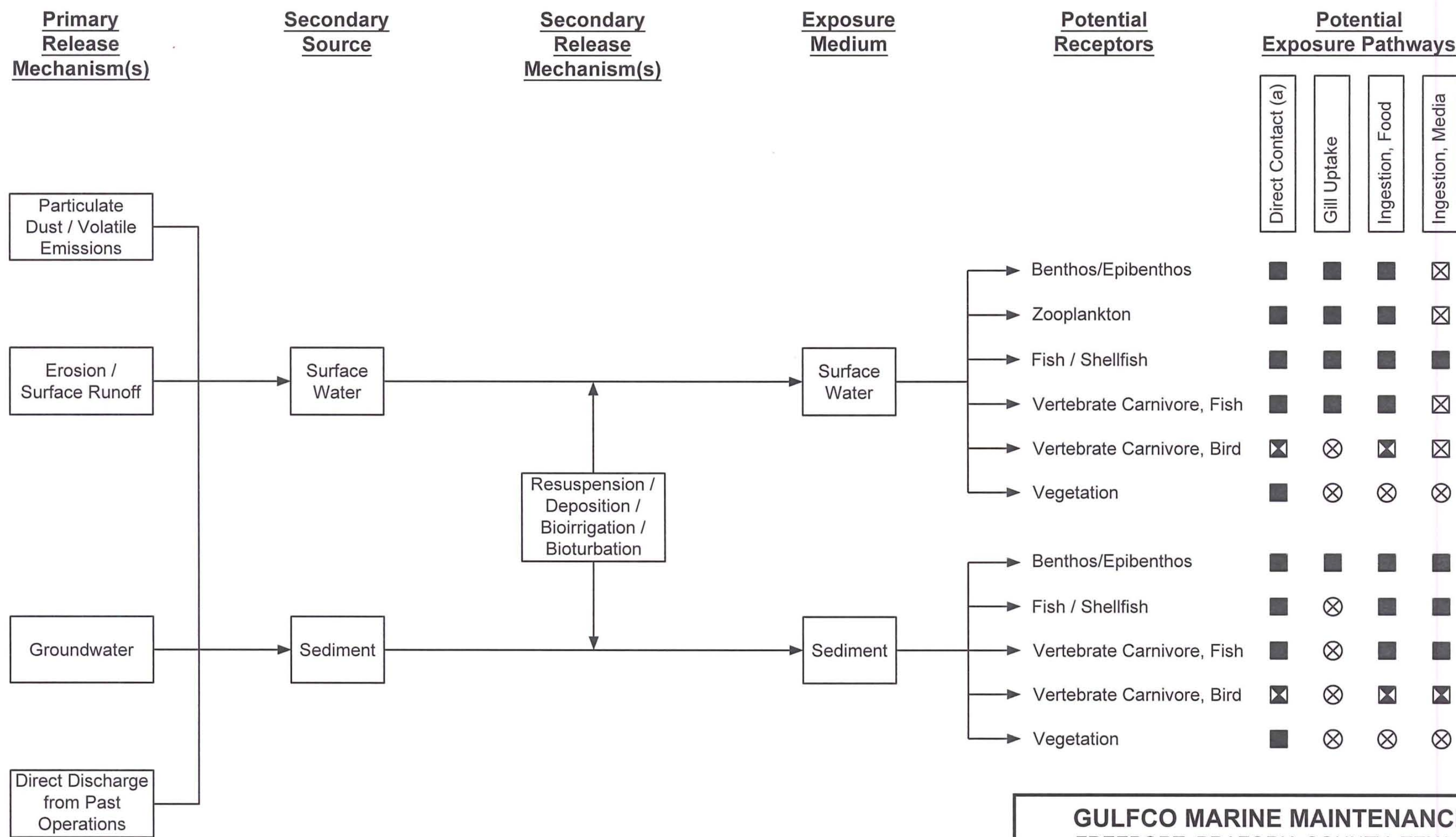

LEGEND

No acceptable risk (Final SLERA conclusion)

Pathway is potentially complete

Pathway is incomplete

Pathway is not viable

(a) Direct contact includes dermal absorption

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 64

CONCEPTUAL SITE MODEL -AQUATIC ECOSYSTEM

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: KHT	

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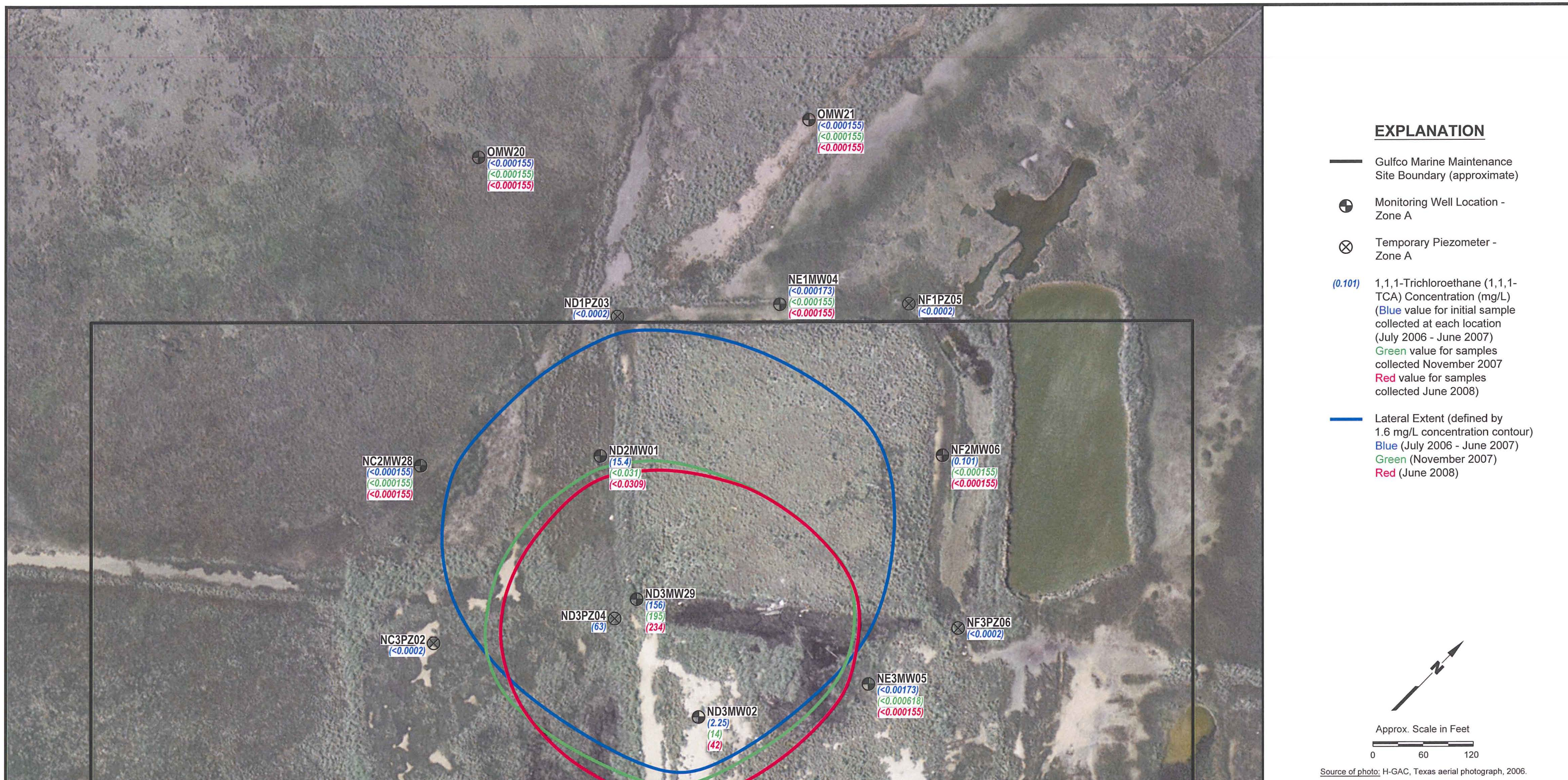

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 65

LATERAL EXTENT OF 1,1,1-TCA CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076918

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(0.037) 1,1-Dichloroethene (1,1-DCE) Concentration (mg/L) (Blue value for initial sample collected at each location (July 2006 - June 2007) Green value for samples collected November 2007 Red value for samples collected June 2008)

Lateral Extent (defined by 0.7 mg/L concentration contour) Blue (July 2006 - June 2007) Green (November 2007) Red (June 2008)

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 66

LATERAL EXTENT OF 1,1-DCE CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(0.214) 1,2,3-Trichloropropane (1,2,3-TCP) Concentration (mg/L) (Blue value for initial sample collected at each location (July 2006 - June 2007) Green value for samples collected November 2007 Red value for samples collected June 2008)

Lateral Extent (defined by 0.029 mg/L concentration contour) Blue (July 2006 - June 2007) Green (November 2007) Red (June 2008)

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet
0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 67

LATERAL EXTENT OF 1,2,3-TCP CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(<0.037) 1,2-Dichloroethane (1,2-DCA) Concentration (mg/L) (Blue value for initial sample collected at each location (July 2006 - June 2007) Green value for samples collected November 2007 Red value for samples collected June 2008)

Lateral Extent (defined by 0.5 mg/L concentration contour) Blue (July 2006 - June 2007) Green (November 2007) Red (June 2008)

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 68

LATERAL EXTENT OF 1,2-DCA CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(5.39J) Benzene Concentration (mg/L) (Blue value for initial sample collected at each location (July 2006 - June 2007) Green value for samples collected November 2007 Red value for samples collected June 2008)

Lateral Extent (defined by 0.1 mg/L concentration contour) Blue (July 2006 - June 2007) Green (November 2007) Red (June 2008)

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet
0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 69

LATERAL EXTENT OF BENZENE CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(0.048) Cis-1,2-Dichloroethene (cis-1,2-DCE) Concentration (mg/L) (Blue value for initial sample collected at each location (July 2006 - June 2007) Green value for samples collected November 2007 Red value for samples collected June 2008)

Lateral Extent (defined by 7 mg/L concentration contour) Blue (July 2006 - June 2007) Green (November 2007) Red (June 2008)

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 70

LATERAL EXTENT OF CIS-1,2-DCE CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(0.944) Methylene Chloride Concentration (mg/L) (Blue value for initial sample collected at each location (July 2006 - June 2007) Green value for samples collected November 2007 Red value for samples collected June 2008)

Lateral Extent (defined by 0.5 mg/L concentration contour) Blue (July 2006 - June 2007) Green (November 2007) Red (June 2008)

Note:
Data Qualifier: J = Estimated value, B = Analyte detected in associated method blank.

N

Approx. Scale in Feet
0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 71

LATERAL EXTENT OF METHYLENE CHLORIDE CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(0.049J) Tetrachloroethene (PCE) Concentration (mg/L) (Blue value for initial sample collected at each location (July 2006 - June 2007) Green value for samples collected November 2007 Red value for samples collected June 2008)

Lateral Extent (defined by 0.5 mg/L concentration contour) Blue (July 2006 - June 2007) Green (November 2007) Red (June 2008)

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 72

LATERAL EXTENT OF PCE CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076925

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(0.506) Trichloroethene (TCE) Concentration (mg/L) (Blue value for initial sample collected at each location (July 2006 - June 2007) Green value for samples collected November 2007 Red value for samples collected June 2008)

Lateral Extent (defined by 0.5 mg/L concentration contour) Blue (July 2006 - June 2007) Green (November 2007) Red (June 2008)

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 73

LATERAL EXTENT OF TCE CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Monitoring Well Location - Zone A

Temporary Piezometer - Zone A

(<3.27) Vinyl Chloride Concentration (mg/L) (Blue value for initial sample collected at each location (July 2006 - June 2007) Green value for samples collected November 2007 Red value for samples collected June 2008)

Lateral Extent (defined by 0.2 mg/L concentration contour) Blue (July 2006 - June 2007) Green (November 2007) Red (June 2008)

Note:
Data Qualifier: J = Estimated value.

N

Approx. Scale in Feet
0 60 120

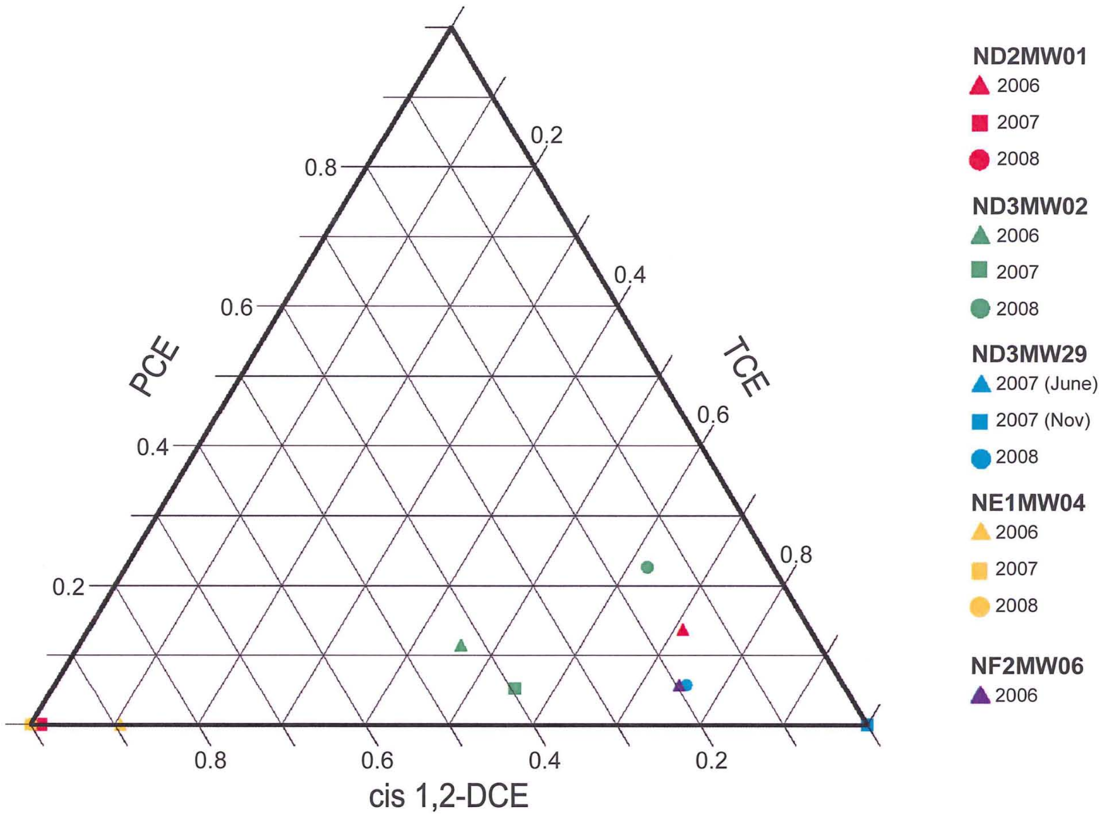
Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 74
LATERAL EXTENT OF VINYL CHLORIDE CONCENTRATIONS IN ZONE A JULY 2006 THROUGH JUNE 2008

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 75

ZONE A CHLORINATED ETHENE MOLE FRACTIONS

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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PLATES

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Crab/Fish Tissue Sampling Zones
- Monitoring Well
- Temporary Piezometer
- CPT Piezometer Location
- Wetland Sediment Sample
- Pond or Intracoastal Waterway Sediment Sample
- Surface Water Sample
- Surface Soil Sample (0-1 in)
- Shallow Soil Sample
- Western Extent Soil Sample
- Zone B Soil Boring
- Deep Soil Boring Location
- Geotechnical Soil Sample

N

Scale in Feet

0 100 200

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE

FREEPORT, BRAZORIA COUNTY, TEXAS

PLATE 1

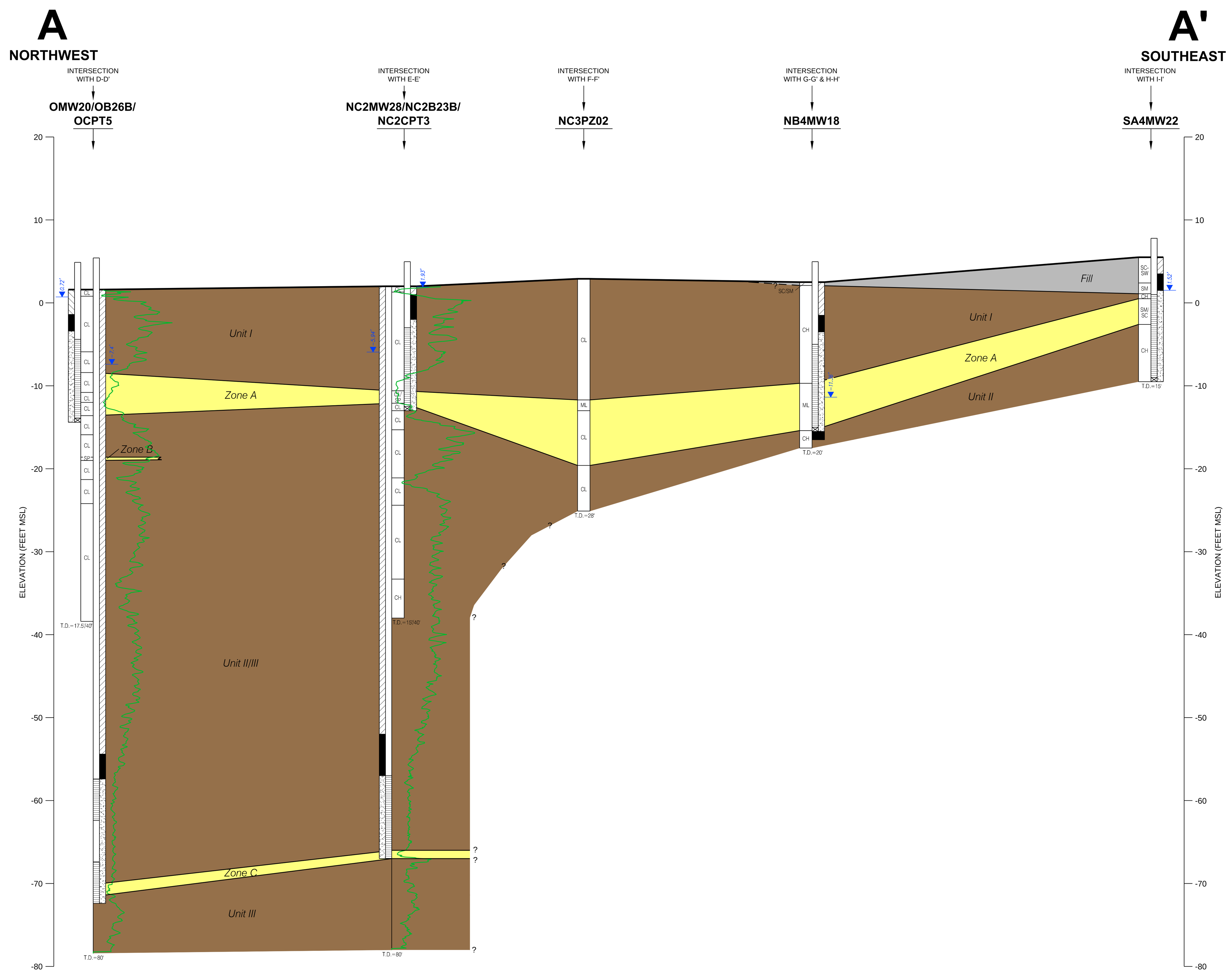
REMEDIAL INVESTIGATION SAMPLE LOCATIONS

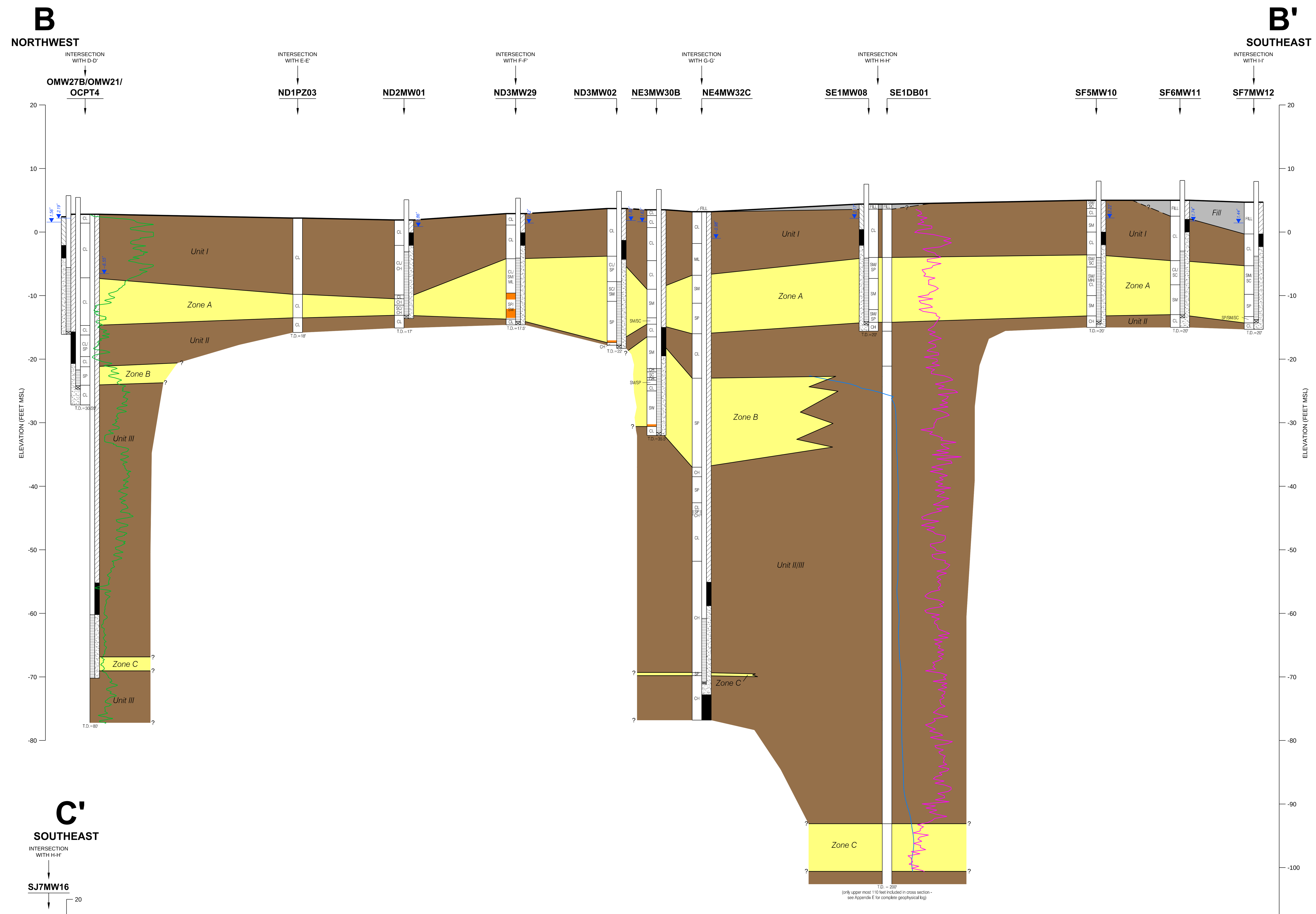
PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

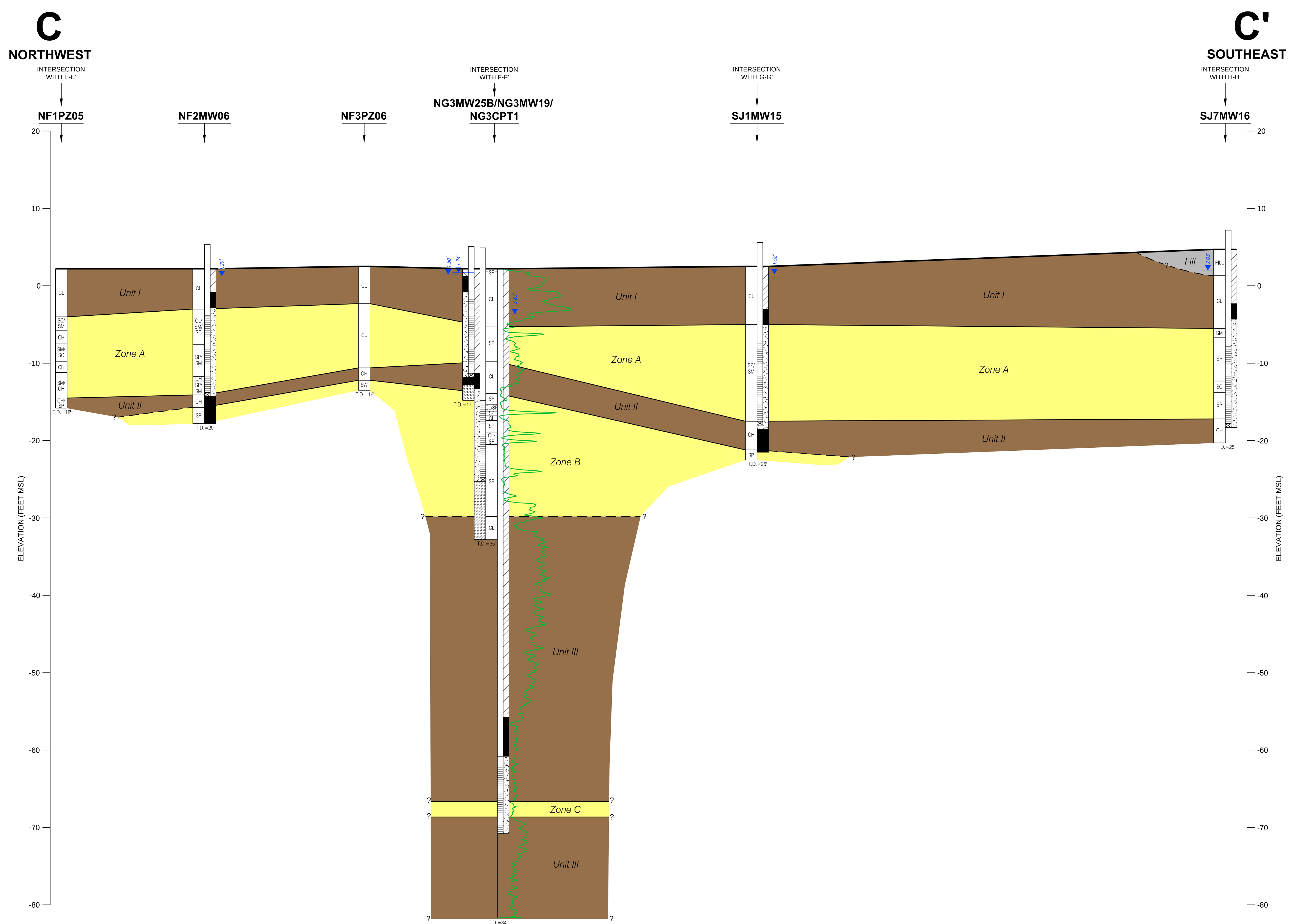
PASTOR, BEHLING & WHEELER, LLC

CONSULTING ENGINEERS AND SCIENTISTS

076930

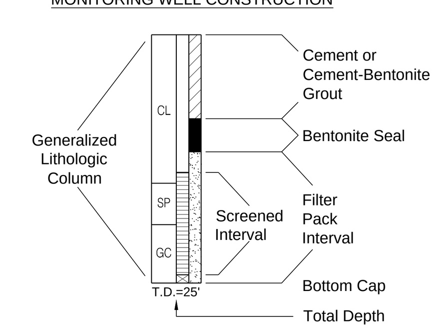






EXPLANATION

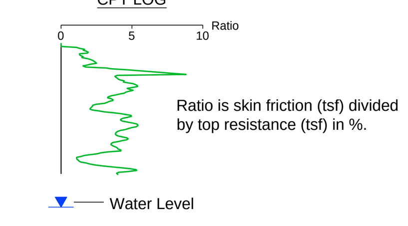
MONITORING WELL CONSTRUCTION



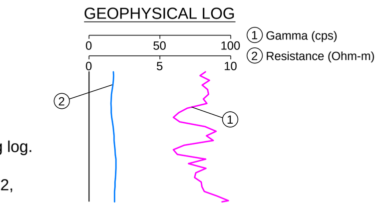
GENERALIZED LITHOLOGIC ABBREVIATIONS

Fill	Fill Material
CH	Fat Clay, High Plasticity
CL	Sandy, or Silty Clay, Lean, Low to Medium Plasticity
ML	Sandy Silt
MH	Elastic Silt with Sand
SC	Clayey Sand, Plastic Fines (≥15% Fines)
SM	Silty Sand, Non-Plastic Fines (≥15% Fines)
SP	Poorly Graded Sand
SW	Well Graded Sand
(orange)	Highlighted interval in lithologic profile indicates Non-Aqueous Phase Liquid (NAPL) observed in soil core from that depth interval.

CPT LOG

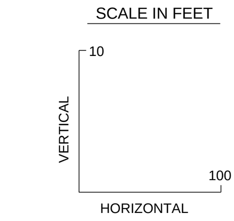


GEOPHYSICAL LOG



Notes:
1. Hydrostratigraphic unit (e.g., Zone A, Zone B) boundaries based on detailed lithologic descriptions in boring log.
2. See Figure 22 for cross section locations.
3. Water levels measured June 6, 2007 except NE3MW30B, NE4MW31B, NE4MW32C, NG3CPT1, NG3CPT2, NG3CPT3 and OCPT4 measured July 30, 2008 and OCPT5 measured January 13, 2009.

SCALE IN FEET



10x Vertical Exaggeration

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

PLATE 2

CROSS SECTIONS A-A' THROUGH C-C'

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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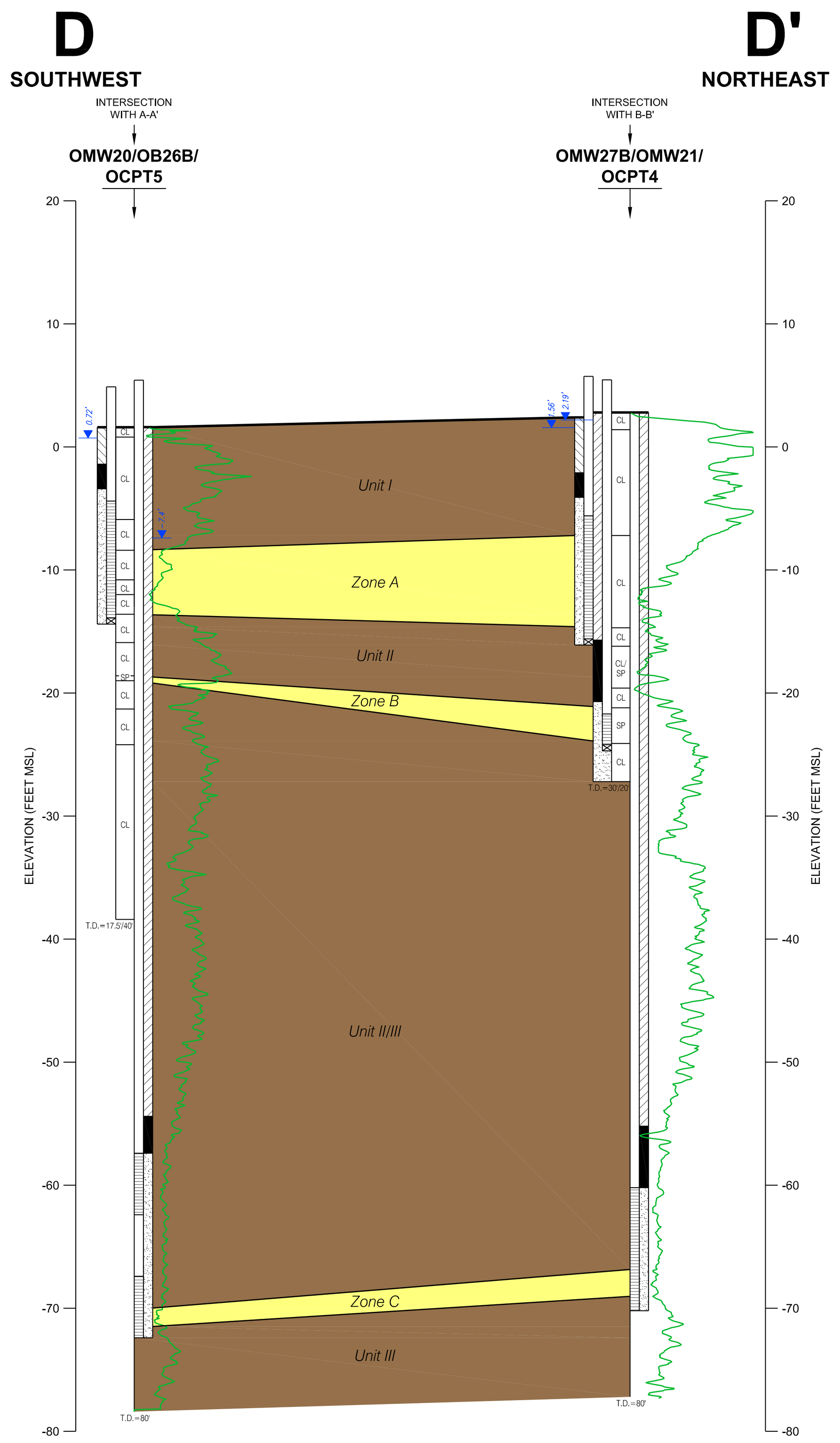
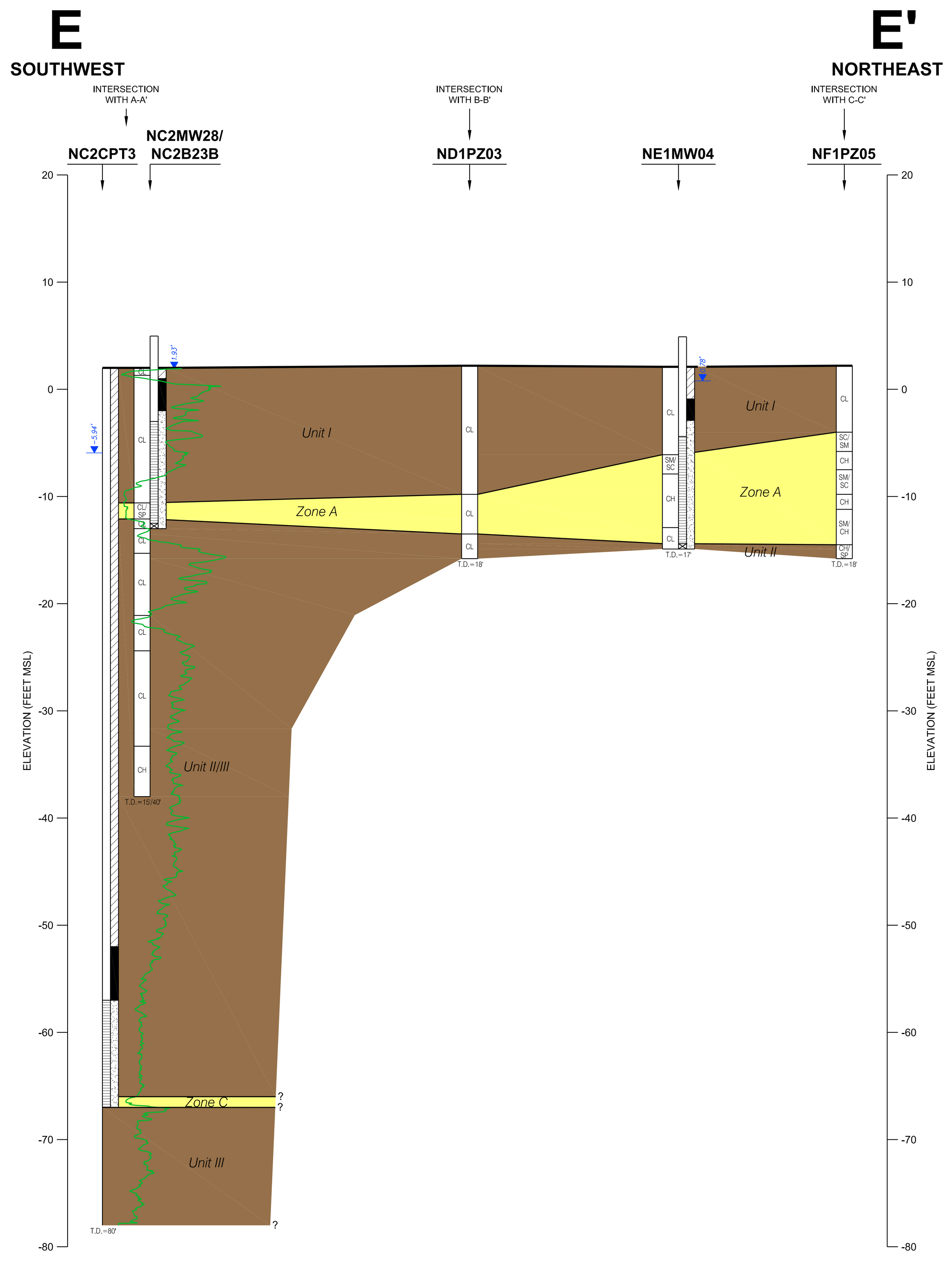
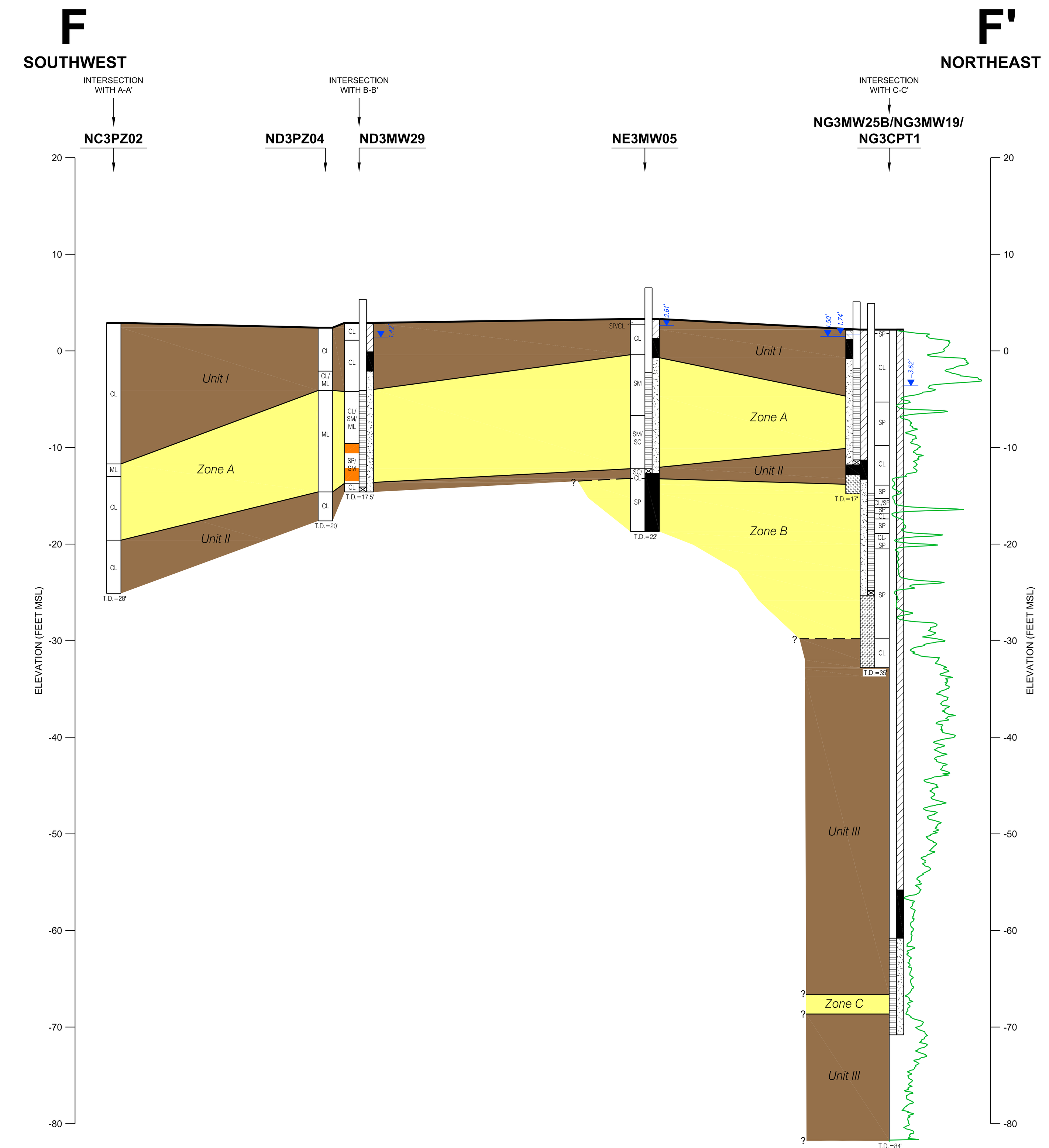
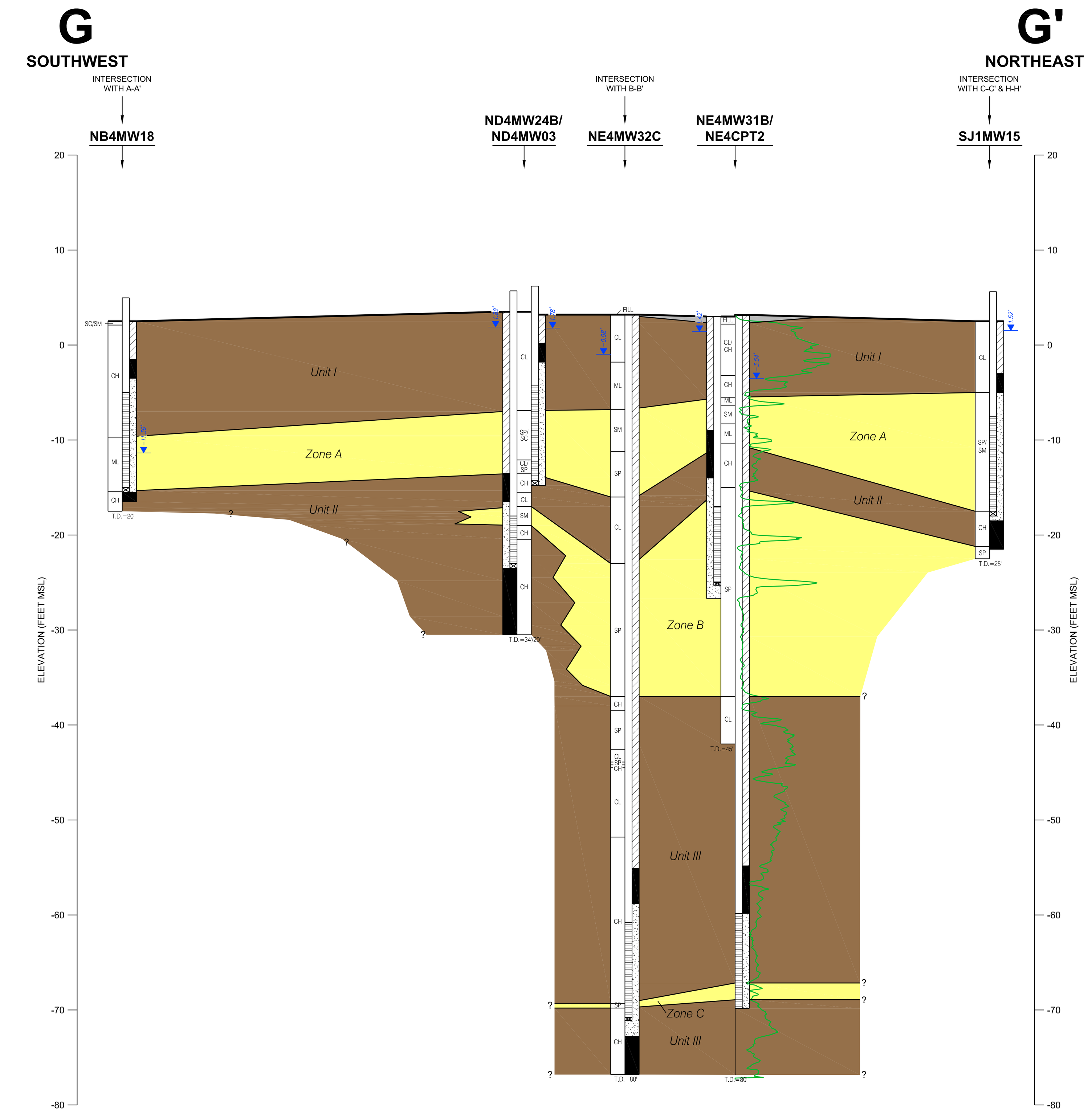
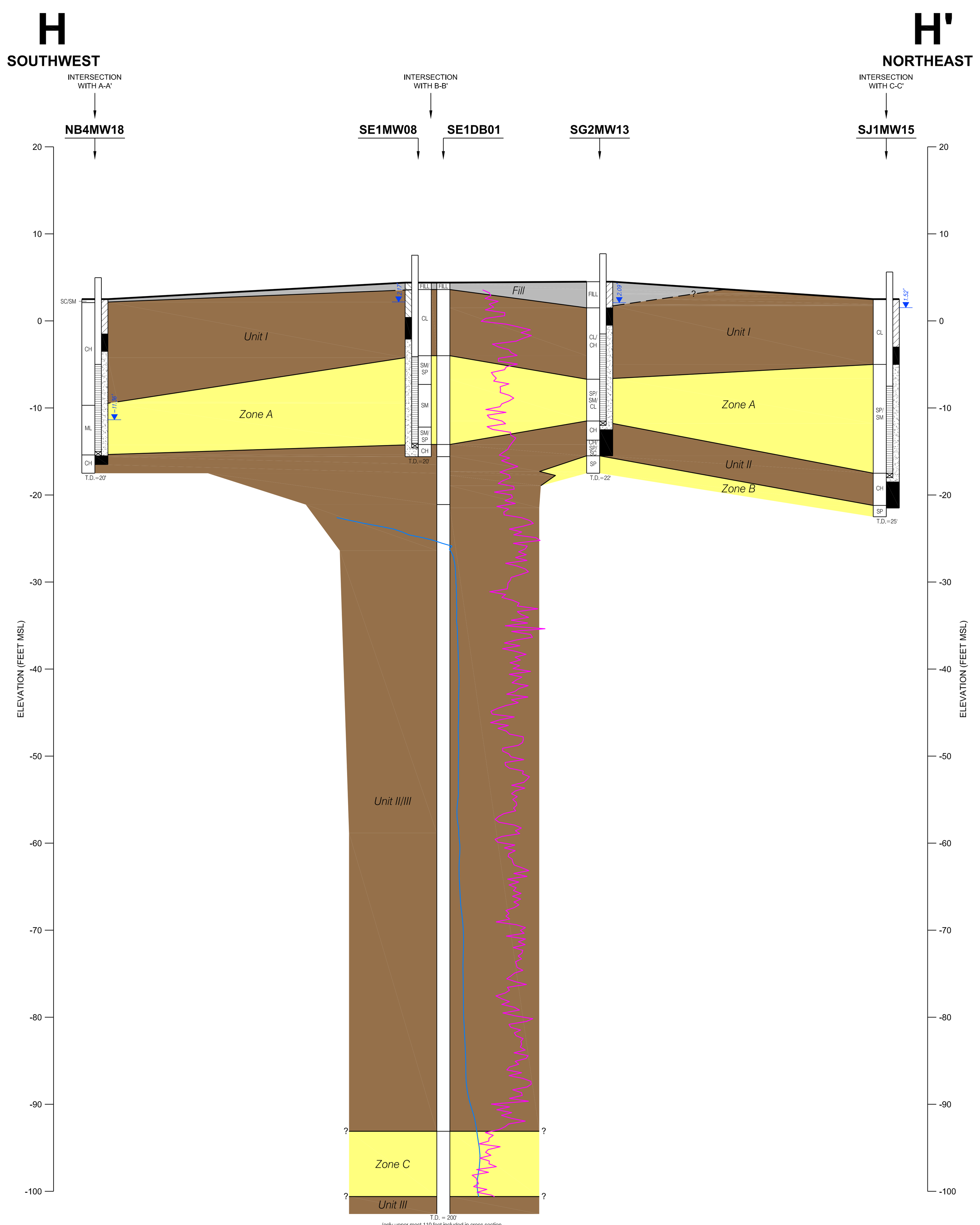
076931

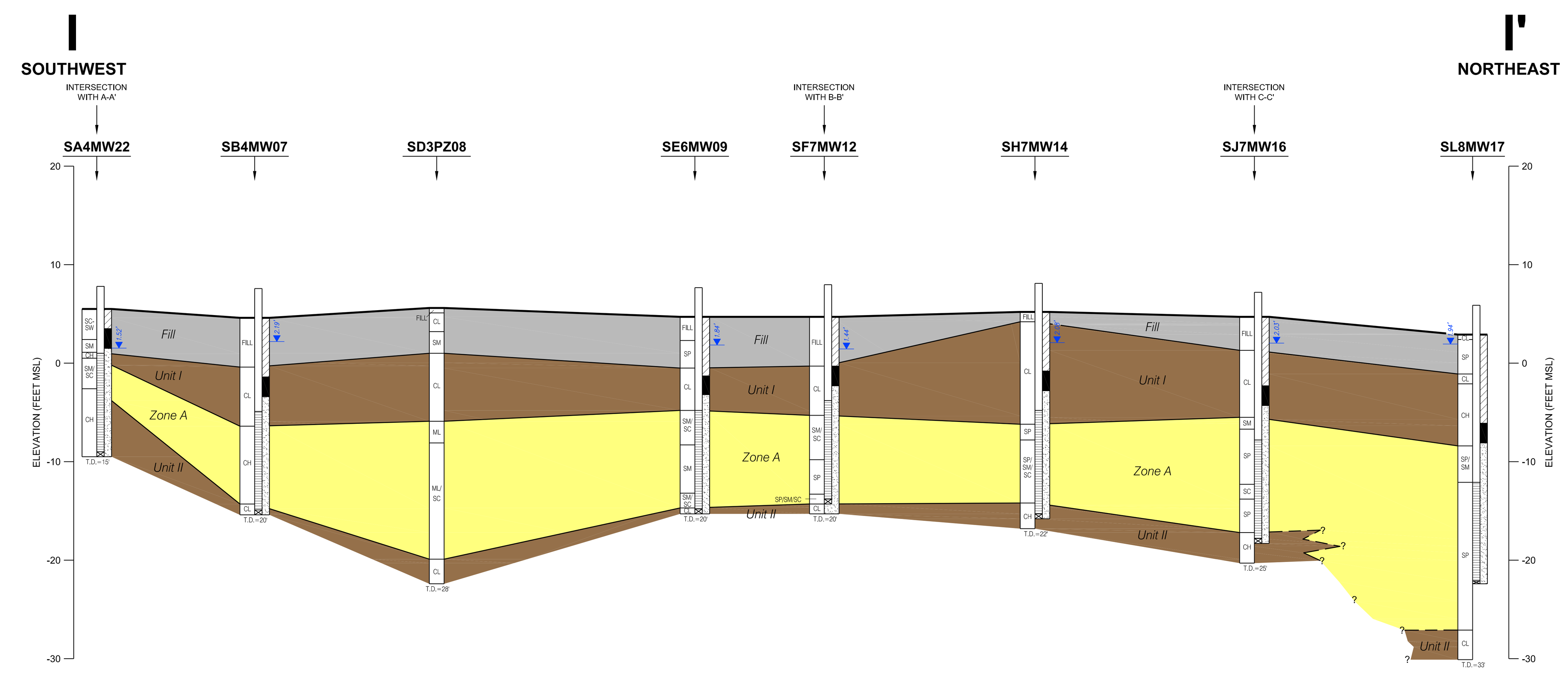






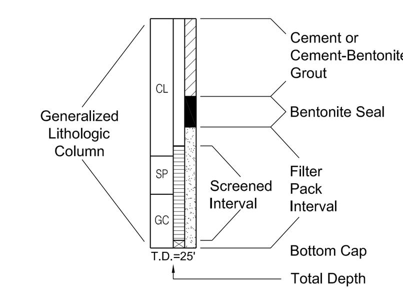






EXPLANATION

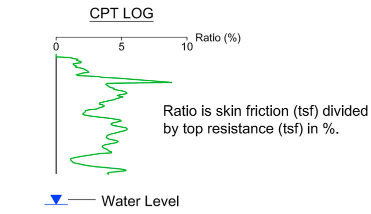
MONITORING WELL CONSTRUCTION



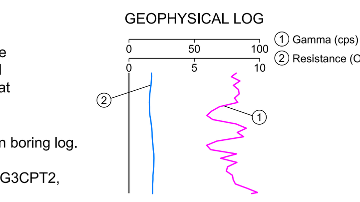
GENERALIZED LITHOLOGIC ABBREVIATIONS

Fill	Fill Material
CH	Fat Clay, High Plasticity
CL	Sandy, or Silty Clay, Lean, Low to Medium Plasticity
ML	Sandy Silt
MH	Elastic Silt with Sand
SC	Clayey Sand, Plastic Fines (≥15% Fines)
SM	Silty Sand, Non-Plastic Fines (≥15% Fines)
SP	Poorly Graded Sand
SW	Well Graded Sand
	Highlighted interval in lithologic profile indicates Non-Aqueous Phase Liquid (NAPL) observed in soil core from that depth interval.

CPT LOG

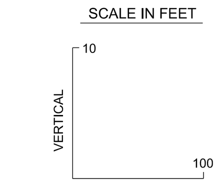


GEOPHYSICAL LOG



Notes:
1. Hydrostratigraphic unit (e.g., Zone A, Zone B) boundaries based on detailed lithologic descriptions in boring log.
2. See Figure 22 for cross section locations.
3. Water levels measured June 6, 2007 except NE3MW30B, NE4MW31B, NE4MW32C, NG3CPT1, NG3CPT2, NG3CPT3 and OCPT4 measured July 30, 2008 and OCPT5 measured January 13, 2009.

SCALE IN FEET



10x Vertical Exaggeration

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

PLATE 3

CROSS SECTIONS D-D' THROUGH I-I'

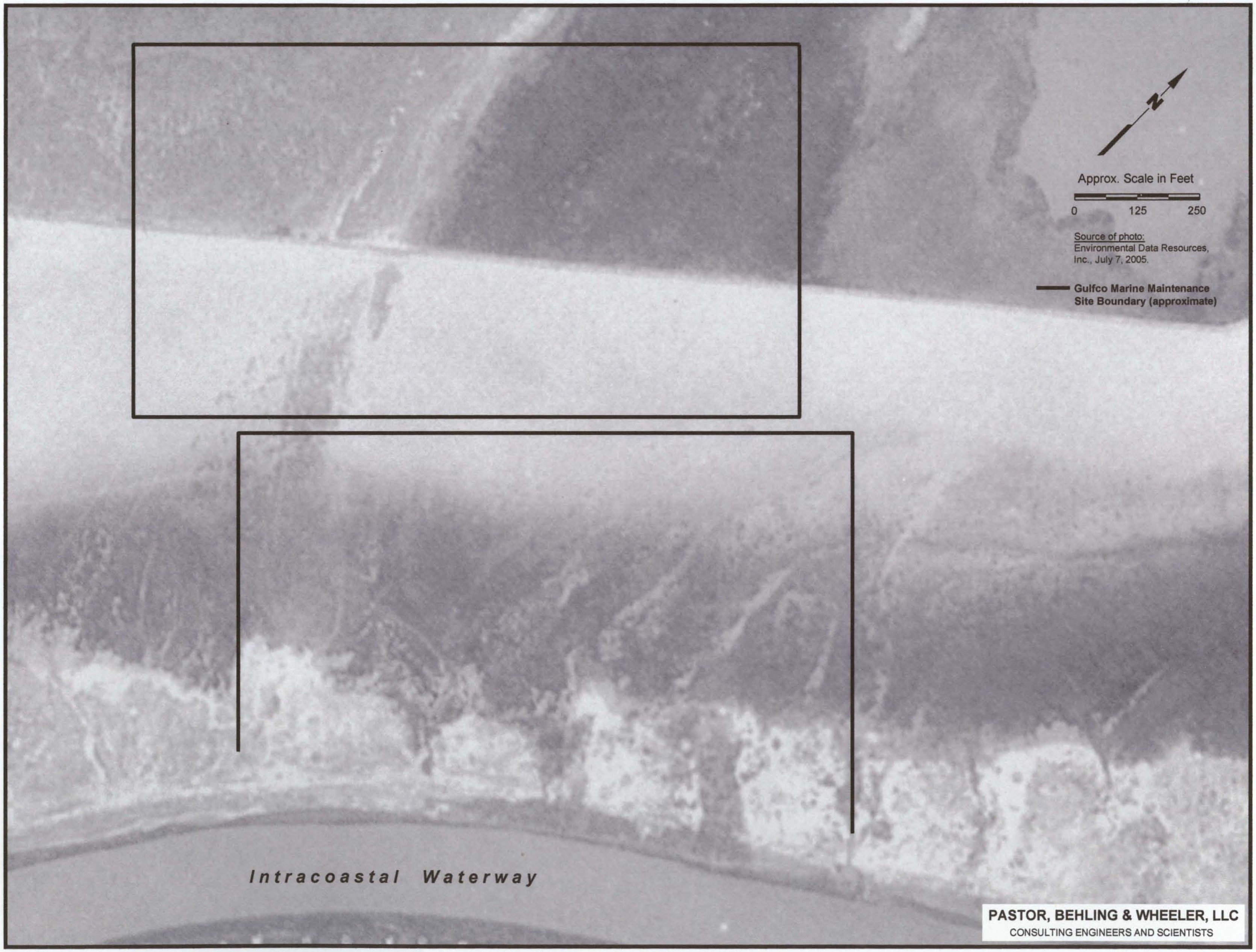
PROJECT: 1352	BY: ZGK	REVISIONS
DATE: APRIL, 2011	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

076932

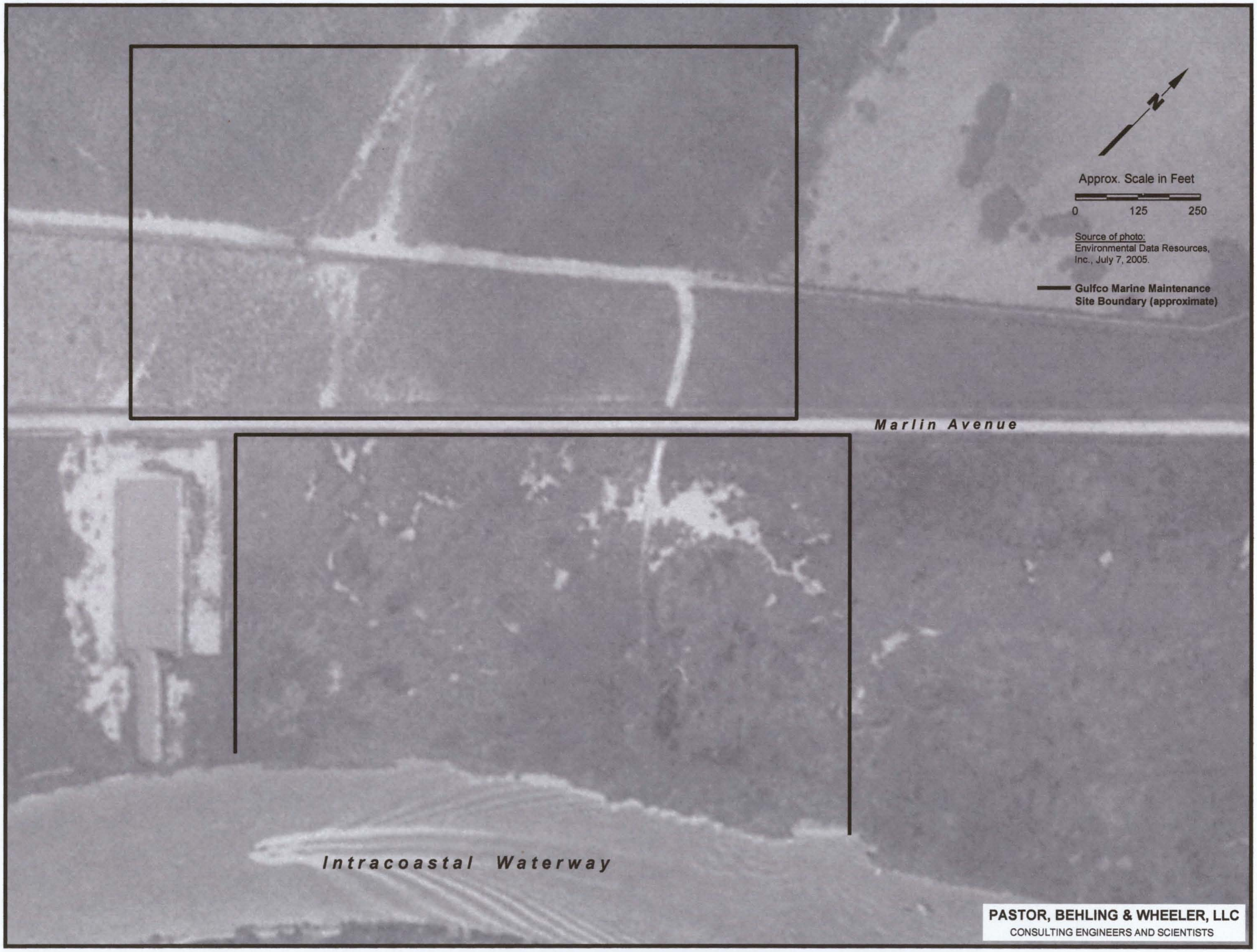
APPENDIX A

HISTORICAL AERIAL PHOTOGRAPHS



1944 AERIAL PHOTOGRAPH

076934



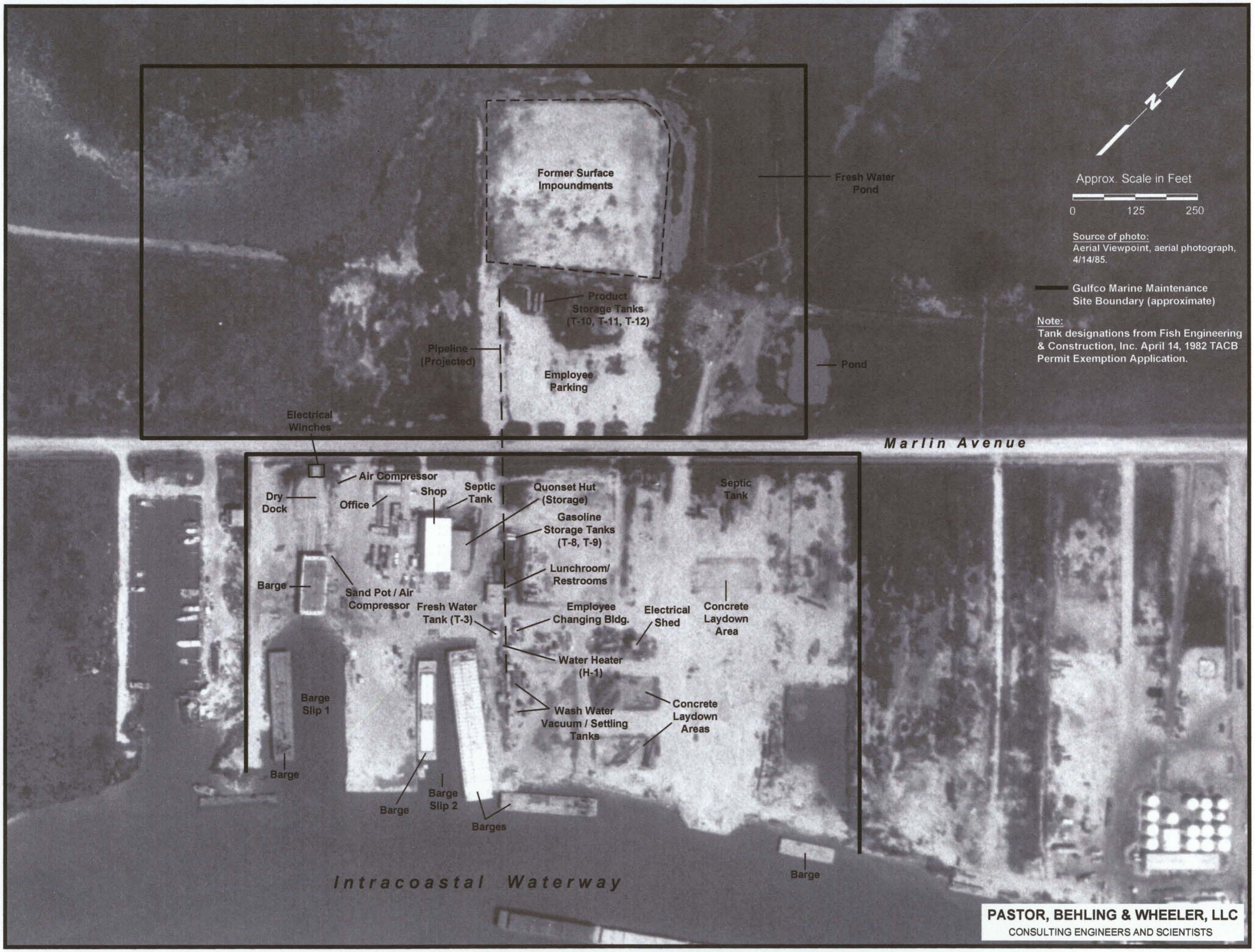
1965 AERIAL PHOTOGRAPH

JUNE 28, 1974 AERIAL PHOTOGRAPH

076936

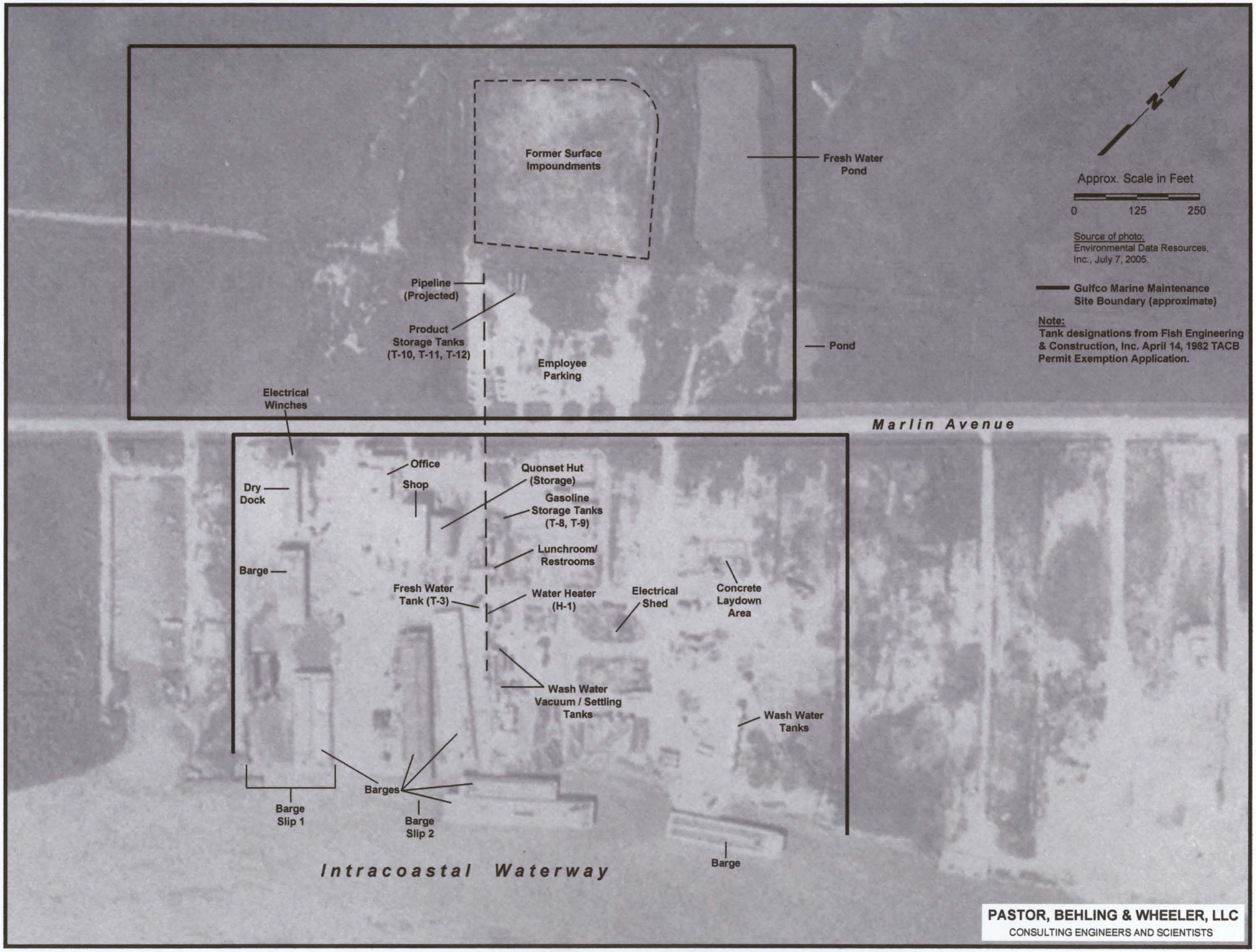
1977 AERIAL PHOTOGRAPH - Gulfco Marine Maintenance Operations

076937



1985 AERIAL PHOTOGRAPH - Fish Engineering Operations

076938

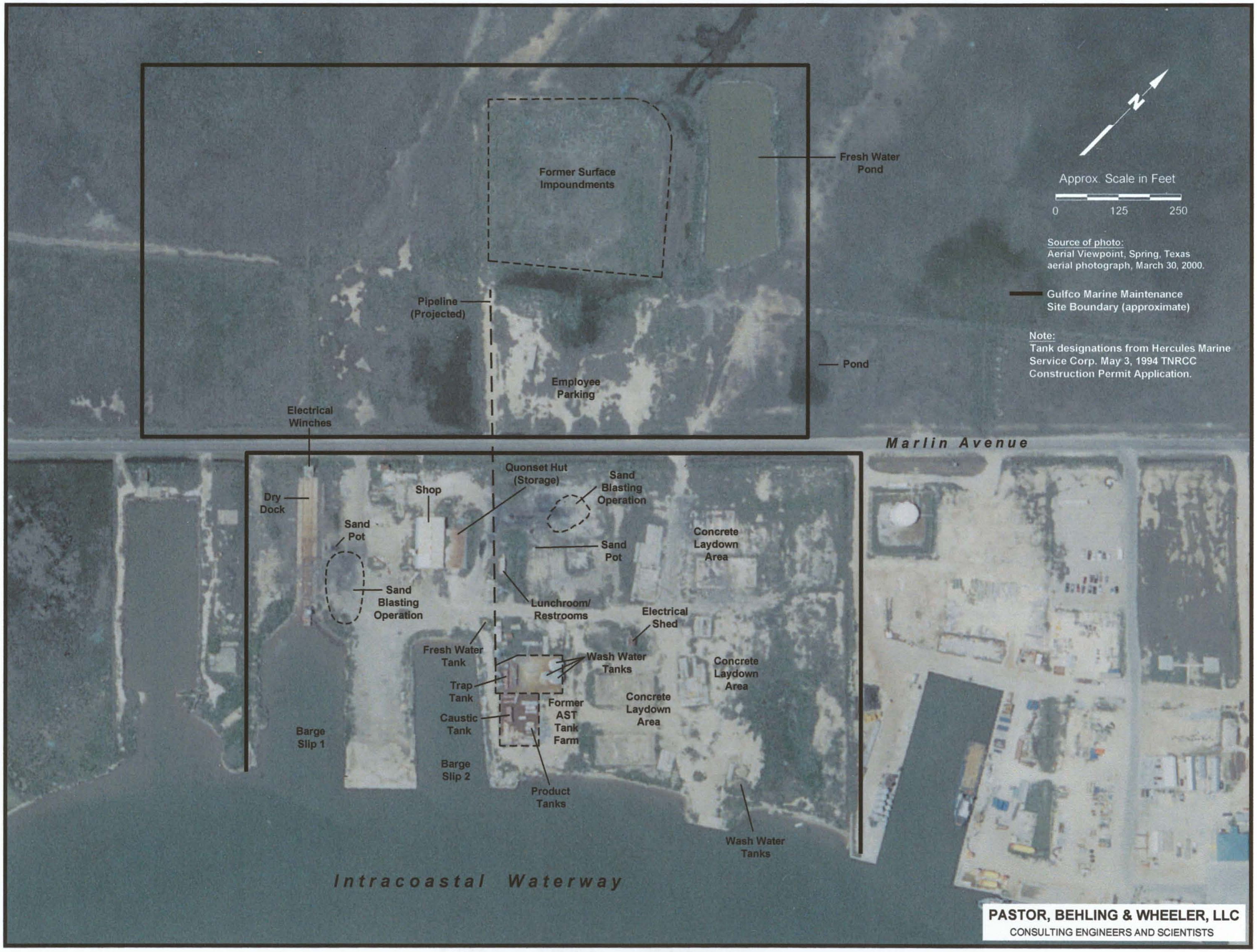


1987 AERIAL PHOTOGRAPH - Fish Engineering Operations

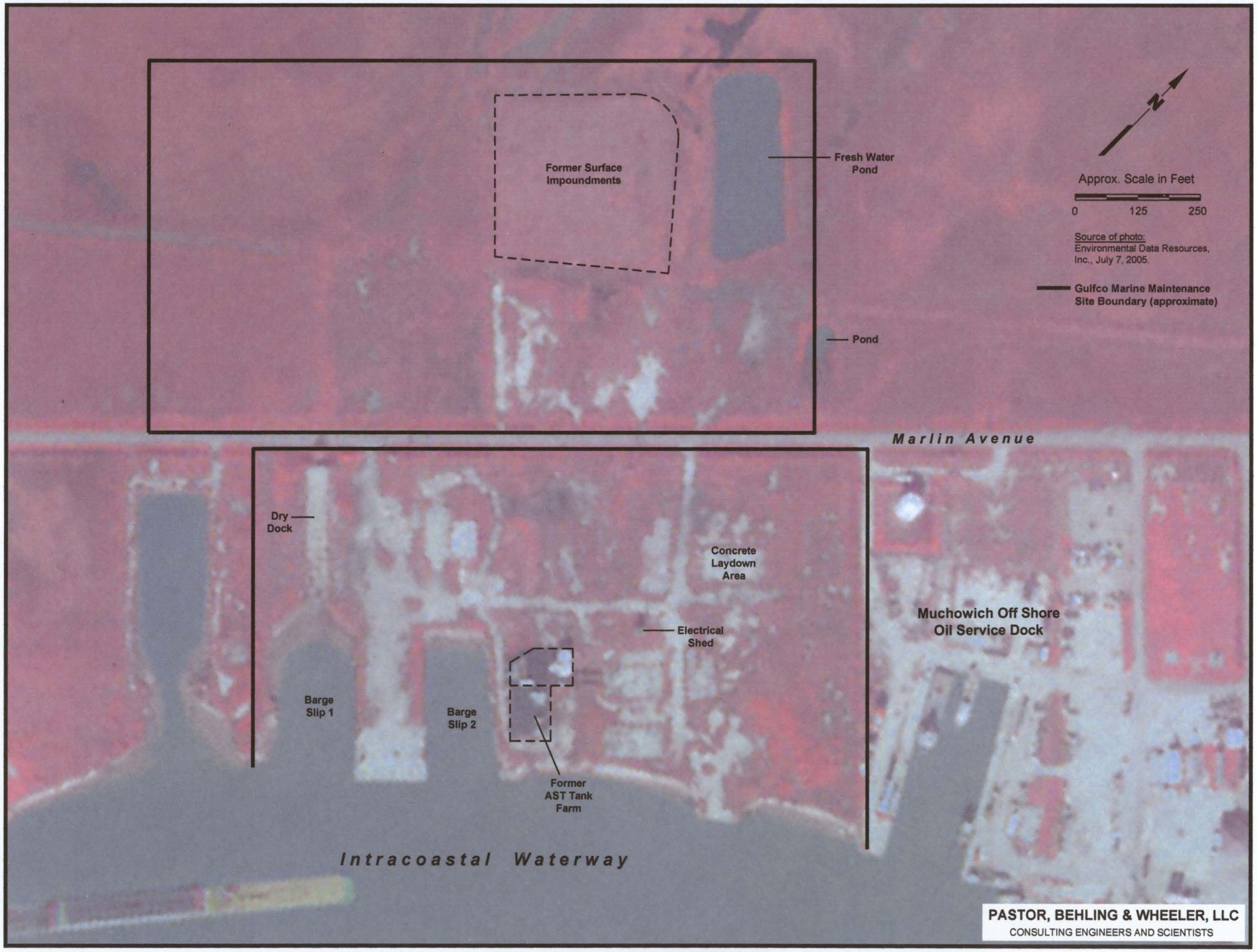
076939

1995 AERIAL PHOTOGRAPH - Hercules Operations

076940



2000 AERIAL PHOTOGRAPH



2004 AERIAL PHOTOGRAPH

076942

APPENDIX B

RI ANALYTICAL LABORATORY REPORTS, VALIDATION REPORTS, HYDRAULIC TESTING DATA, AND ANALYTICAL DATABASE ELECTRONIC FILES (ON DVD)

APPENDIX C

SOIL BORING LOGS/WELL CONSTRUCTION DIAGRAMS

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: ND2-GT-01		
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date: 07/24/06	Borehole Diameter (in.):	1
	Drilling Company: Best Drilling Services, Inc.	Total Depth (ft):	4
	Field Supervisor: Len Mason, P.G.	Northing:	---
PBW Project No. 1352	Drilling Method: Geoprobe	Easting:	---
	Sampling Method: Shelby Tube	Ground Elev. (ft. AMSL):	---

Depth (ft)	Sample (Gray Area)	Recovery (ft/ft)	USCS	Lithologic Description
0 – 2.9	0 – 1.55	3.9/4	CL	(0.0 to 2.9) Slightly sandy, slightly silty CLAY, dark grayish-brown to brown, very fine-grained sand, subrounded, poorly sorted, occasional stringers of silty sand, firm, medium to high plasticity, slightly moist, shell material observed at surface.
2.9 – 4			CH	(2.9 to 4.0) CLAY, dark gray with black staining, some partially decayed organic matter, soft, high plasticity, slightly moist, possible hydrocarbon odor.

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Comments:

- A soil sample was collected adjacent to the geoprobe borehole using a shelby tube.
- This boring log should not be used seperately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: ND2-GT-02			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	07/24/06	Borehole Diameter (in.):	1
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	4
	Field Supervisor:	Len Mason, P.G.	Northing:	---
	Drilling Method:	Geoprobe	Easting:	---
PBW Project No. 1352	Sampling Method:	Shelby Tube	Ground Elev. (ft. AMSL):	---

Depth (ft)	Sample (Gray Area)	Recovery (ft/ft)	USCS	Lithologic Description
0			Shells	(0.0 to 0.4) SHELL material, fractured.
			CL	(0.4 to 0.9) Slightly silty CLAY, gray and yellowish-brown, mottled, firm, medium to high plasticity, slightly moist.
1				
2		3.5/4	CL	(0.9 to 3.2) Silty CLAY, dark grayish-brown and brown, occasional silt lenses, firm, medium to high plasticity, slightly moist.
3				
				(3.2 to 3.5) CLAY, yellowish-brown to light greenish-gray, firm, medium to high plasticity, slightly moist.
4				

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Comments:

- A soil sample was collected adjacent to the geoprobe borehole using a shelby tube.

- This boring log should not be used seperately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: NE1-GT-03			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	07/24/06	Borehole Diameter (in.):	1
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	4
	Field Supervisor:	Len Mason, P.G.	Northing:	---
PBW Project No. 1352	Drilling Method:	Geoprobe	Easting:	---
	Sampling Method:	Shelby Tube	Ground Elev. (ft. AMSL):	---

Depth (ft)	Sample (Gray Area)	Recovery (ft/ft)	USCS	Lithologic Description
0			Shells	(0.0 to 0.3) SHELL material.
1			CL	(0.3 to 2.1) Slightly sandy, slightly silty CLAY, dark grayish brown and brown, thin silty sand stringers, firm, medium plasticity, slightly moist.
2		4/4	ML	(2.1 to 2.5) Clayey SILT, white with some black, soft, uncohesive, moist.
3			CL	(2.5 to 4.0) CLAY, dark gray with black staining, soft, medium plasticity, odor, hydrocarbon staining within clay matrix.
4				

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Comments:

- A soil sample was collected adjacent to the geoprobe borehole using a shelby tube.

- This boring log should not be used seperately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: NE2-GT-04			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	07/24/06	Borehole Diameter (in.):	1
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	4
	Field Supervisor:	Len Mason, P.G.	Northing:	---
PBW Project No. 1352	Drilling Method:	Geoprobe	Easting:	---
	Sampling Method:	Shelby Tube	Ground Elev. (ft. AMSL):	---

Depth (ft)	Sample (Gray Area)	Recovery (ft/ft)	USCS	Lithologic Description
0–1.3	0.2–1.3 (gray area)	3.9/4	CL	(0.0 to 1.3) Slightly sandy, silty CLAY, gray to yellowish-brown, mottled, firm, medium plasticity, slightly moist, shell material observed at surface.
1.3–3.6				(1.3 to 3.6) Silty CLAY, dark grayish-brown and brown, firm, medium plasticity, slightly moist.
3.6–4.0				(3.6 to 4.0) CLAY, dark gray with black staining, moist, odor, hydrocarbon sheen in clay matrix.

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Comments:

- A soil sample was collected adjacent to the geoprobe borehole using a shelby tube.
- This boring log should not be used seperately from the original report.

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

Log of Boring: ND2MW01

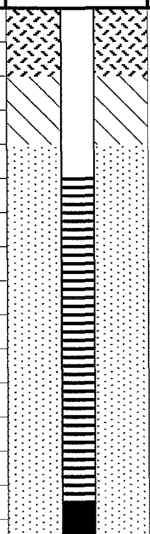
Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/21/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	17
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554817.58
Drilling Method:	Hollow Stem Auger	Easting:	3154371.56
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	1.9
		TOC Elev. (ft MSL)	5.09

Depth (ft): 0, 5, 10, 15, 20, 25, 30

Well Construction Diagram



PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
17.1, 12.6	5/5	CL	(0.0 to 4.0) Silty sandy CLAY, brown to reddish-brown and gray, moist at 0.0 to 1.7, locally wet below 1.7, locally fractured.
13.7, 16.8, 19	5/5	CL/CH	(4.0 to 11.8) Silty CLAY, reddish-brown to gray, moist to locally wet, medium to high plasticity, firm, locally fractured, wet along fractures.
21.9, 26.5	5/5	CL	(11.8 to 12.4) Sandy silty CLAY, reddish-brown, moist to wet, ~20% sand as thin interbeds and lenses, medium plasticity silty clay, firm.
		CH	(12.4 to 13.4) Sandy CLAY with oyster shells, ~50% high plasticity, soft.
42.4		SC/CH	(13.4 to 15.0) Sandy silty CLAY, gray, wet, ~50% very fine-grained to fine-grained sand, ~ 50% high plasticity fines, soft.
345	2/2	CL	(15.0 to 17.0) Sandy CLAY, gray with dark brown staining along fractures, moist, ~10% to 20% fine-grained sand, 80% to 90% medium to low plasticity clay, very stiff, fractured with brown staining along fractures, chemical odor, borehole allowed to slough in to 15.5 for well construction.

PBW
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2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Well Materials
(0.0 to 5.0) Casing, 2" sch. 40 PVC
(5.0 to 15.0) Screen, 2" sch. 40 PVC, 0.01 slot
(15.0 to 15.5) End Cap

Annular Materials
(0.0 to 2.0) Portland Cement with ~ 5% bentonite gel
(2.0 to 4.0) Bentonite chips, 3/8"
(4.0 to 15.5) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

Log of Boring: ND3MW02

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/17/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	22
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554692.51
Drilling Method:	Hollow Stem Auger	Easting:	3154679.33
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	3.7
		TOC Elev. (ft MSL)	6.41

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0		0.5/0.5	CL	(0.0 to 0.5) Sandy CLAY, brown, moist, ~ 30% to 40% fine-grained sand, ~ 60% to 70% medium plasticity clay, firm.
	16.4	1.5/1.5	CL	(0.5 to 2.0) Sandy CLAY as above, trace black mottling at 2.2, decrease in sand content below 2.0.
	14	5/5	CL	
5	9.5		CL	(2.0 to 7.5) Sandy CLAY as above with local fractures, wet.
	6.8	5/5		
	0.7		CL/SP	(7.5 to 11.5) Sandy CLAY, brown, wet, ~ 20% to 50% fine-grained sand, ~ 50% to 80% high plasticity clay.
10	5.4			
	7.4	5/5	SC/SM	(11.5 to 14.6) Clayey silty SAND, brown, wet, ~ 30% to 50% medium plasticity fines, ~ 50% to 70% very fine to fine-grained sand, very soft.
15	6.1			
	9.9	5/5	SP	(14.6 to 21.1) Poorly graded SAND, brown, wet, visible NAPL at 21.0 to 21.1 on top of clay, very fine to fine-grained sand, silt locally, soft, running sand.
	315			
20	1755	1.5/1.5	CH	(21.1 to 21.5) Sandy CLAY, brown, moist, ~ 10% fine-grained sand, ~ 90% high plasticity clay, firm, borehole drilled to 22.0 for well construction.
25				
30				

Well Materials
(0.0 to 11.5) Casing, 2" sch. 40 PVC
(11.5 to 21.5) Screen, 2" sch. 40 PVC, 0.01 slot
(21.5 to 22.0) End Cap

Annular Materials
(0.0 to 5.0) Portland Cement with ~ 5% bentonite gel
(5.0 to 8.0) Bentonite chips, 3/8"
(8.0 to 22.0) Sand, 20/40 silica

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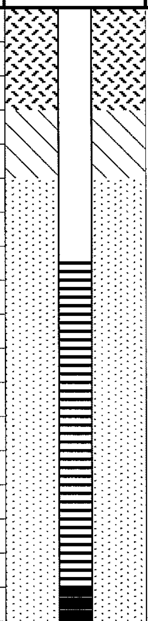
PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: ND4MW03

Gulfco Marine Maintenance Superfund Site Freeport, TX			
	Completion Date: 07/17/06	Borehole Diameter (in.):	8.25
	Drilling Company: Best Drilling Services, Inc.	Total Depth (ft):	20
	Field Supervisor: Tim Jennings, P.G.	Northing:	13554562.67
PBW Project No. 1352	Drilling Method: Hollow Stem Auger	Easting:	3154758.06
	Sampling Method: 5 ft continuous core	Ground Elev. (ft. MSL):	3.2
		TOC Elev. (ft MSL)	6.2

Well Construction Diagram:



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0	0.9	0.5/0.5	CL	(0.0 to 0.2) Silty SAND, light brown, moist, very fine-grained sand, soft.
		1.5/1.5	CL	(0.2 to 0.6) Sandy CLAY, dark brown, moist, ~ 20% very fine-grained sand, ~ 80% medium plasticity clay, slightly firm.
	1.6	5/5	CL	(0.6 to 2.0) Sandy CLAY, dark brown, becomes black below 1.5.
			CL	(2.0 to 4.2) Sandy CLAY, locally black and dark reddish-brown, becomes highly plastic below ~ 3.0.
5	1.9	5/5	CL	(4.2 to 8.2) Sandy CLAY as above, reddish-brown, moist, wet below 5.9, with thin sand interbeds locally.
	1.7		CL	(8.2 to 10.4) Sandy CLAY, brown, wet, ~ 40 very fine-grained sand, ~ 60% highly plastic clay, soft.
10	0.8 2.4 2.1	5/5	SP/SC	(10.4 to 15.6) Poorly graded SAND with clayey sand, brown, wet, ~80% fine-grained sand, ~ 20% high plasticity clay, very soft.
15	2.9	5/5	CL/SP	(15.6 to 17.0) Poorly graded SAND and sandy CLAY, brown, wet, ~50% very fine-grained sand, ~ 50% high plasticity clay, very soft.
	3.4		CH	(17.0 to 20.0) Sandy CLAY, brown to grayish brown, wet, <5% fine-grained sand, ~95% high plasticity CLAY, soft, borehole allowed to slough to 18.0 for well construction.
20				
25				
30				

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Well Materials
(0.0 to 7.5) Casing, 2" sch. 40 PVC
(7.5 to 17.5) Screen, 2" sch. 40 PVC, 0.01 slot
(17.5 to 18.0) End Cap

Annular Materials
(0.0 to 3.0) Portland Cement with ~ 5% bentonite gel
(3.0 to 5.0) Bentonite chips, 3/8"
(5.0 to 18.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: NE1MW04			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	07/21/06	Borehole Diameter (in.):	8.25
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	17
	Field Supervisor:	Tim Jennings, P.G.	Northing:	13555097.66
PBW Project No. 1352	Drilling Method:	Hollow Stem Auger	Easting:	3154385.63
	Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	2.1
			TOC Elev. (ft MSL)	4.9

Depth (ft)	Well Construction Diagram	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0		19			
		28.2	5/5	CL	(0.0 to 5.0) Sandy CLAY, dark gray to reddish-brown, moist, ~ 10% to 20% fine-grained sand, ~ 80% to 90% medium to low plasticity clay, very stiff.
5		20.9			
		1	5/5	CL	(5.0 to 8.2) Sandy silty CLAY, gray to brown, wet, ~ 20% to 40% fine-grained sand and silt, 60% - 80% medium to high plasticity clay, soft.
		1.1		SM/SC	(8.2 - 10.0) Silty clayey SAND, brown to gray, wet, ~50% high plasticity silt and clay, ~ 50% very fine-grained to fine-grained sand, firm.
10		1.1			
		0.7	4.5/5	CH	(10.0 to 15.0) Silty sandy CLAY, reddish-brown to gray, wet, ~ 20% to 40% silt and very fine-grained sand, ~ 60% to 80% high plasticity clay, very soft, oyster shells at 11.8 to 12.2.
15			2/2	CL	(15.0 to 16.5) Sandy CLAY with carbonate nodules, gray, wet, ~ 30% fine-grained sand, ~ 20% carbonate nodules, ~ 50% medium plasticity clay, very fractured.
					(16.5 to 17.0) Sandy CLAY, brown, moist, ~ 10% fine-sand, ~ 90% low to medium plasticity clay, very stiff, first confining clay.
20					
25					
30					

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Well Materials

(0.0 to 6.5) Casing, 2" sch. 40 PVC
(6.5 to 16.5) Screen, 2" sch. 40 PVC, 0.01 slot
(16.5 to 17.0) End Cap

Annular Materials

(0.0 to 3.0) Portland Cement with ~ 5% bentonite gel
(3.0 to 5.0) Bentonite chips, 3/8"
(5.0 to 17.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

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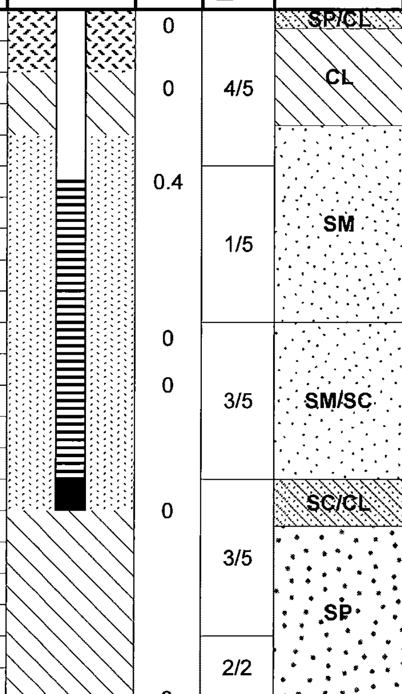
Log of Boring: NE3MW05

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/21/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	22
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554868.05
Drilling Method:	Hollow Stem Auger	Easting:	3154789.25
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	3.3
		TOC Elev. (ft MSL)	6.53



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0	0	4/5	SP/CL	(0.0 to 0.6) SAND and CLAY, brown, moist, ~ 50% medium plasticity clay, 50% medium-grained sand.
	0		CL	(0.6 to 2.3) Sandy CLAY, brown, wet, ~ 30% fine to coarse-grained sand, ~ 70% medium plasticity clays, very soft.
				(2.3 to 3.7) Silty sandy CLAY, gray to black, moist, ~ 10% to 20% silt and fine-grained sand, ~ 80% to 90% medium plasticity clay, firm.
5	0.4	1/5	SM	(3.7 to 10.0) Silty SAND, brown, wet, ~ 30% to 40% fines, ~ 60% to 70% very fine to fine-grained sand, soft, black sludge-like material from groundwater in reducing environment, debris blocking core barrel causing poor recovery, large anchor rope around augers when pulled–likely reason for poor recovery.
10	0 0	3/5	SM/SC	(10.0 to 15.0) Silty clayey SAND, brown, wet, ~ 40% to 50% medium to high plasticity fines, ~ 50% to 60% very fine to fine-grained sand.
15	0	3/5	SC/CL	(15.0 to 16.5) Silty clayey SAND as above with thin interbedded CLAY locally, due to poor recovery very little clay observed, first "confining" clay interpreted at ~ 15.5 to 16.5 with the "lower sand" below ~ 16.5.
			SP	(16.5 to 20.0) Poorly graded SAND with CLAY, brown, wet, very fine to fine-grained sand, very "soupy."
20	0	2/2		(20.0 to 22.0) Poorly graded SAND, brown, wet, very fine to medium-grained sand.

Notes:
1. Hydrocarbon-like sheen on water in borehole, but no visible chemical or hydrocarbon observed in core at any depth.

Well Materials
(0.0 to 5.5) Casing, 2" sch. 40 PVC
(5.5 to 15.5) Screen, 2" sch. 40 PVC, 0.01 slot
(15.5 to 16.0) End Cap

Annular Materials
(0.0 to 2.0) Portland Cement with ~ 5% bentonite gel
(2.0 to 4.0) Bentonite chips, 3/8"
(4.0 to 16.0) Sand, 20/40 silica
(16.0 to 22.0) Bentonite chips, 3/8"

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PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	# Log of Boring: NF2MW06

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/31/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	20
Field Supervisor:	Tim Jennings, P.G.	Northing:	13555117.77
Drilling Method:	Hollow Stem Auger	Easting:	3154650.46
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	2.2
		TOC Elev. (ft MSL)	5.35

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)
0–4	3.4, 3.5	4/4
4–8	3.1, 2.8	4/4
8–12	2.8, 4.1	4/4
12–16	4.7, 5.6	4/4
16–20	6.1, 6.3	4/4

USCS	Lithologic Description
CL	(0.0 to 0.7) Sandy CLAY, brown, moist, ~ 20% fine-grained sand, ~ 80% medium plasticity clay, firm, abundant roots.
CL	(0.7 to 5.2) Silty CLAY, gray to brown, moist, medium plasticity, firm.
CL/SM/SC	(5.2 to 9.8) Silty sandy CLAY and clayey silty SAND, gray to brown, wet, ~ 40% to 50% very fine-grained sand, ~ 50% to 60% medium plasticity clay and silt, soft to slightly firm.
SP/SM	(9.8 to 13.9) Poorly graded SAND and silty SAND, brown, wet, ~ 20% to 30% low plasticity fines, ~ 70% to 80% very fine to fine-grained sand.
CH	(13.9 to 14.5) Silty CLAY, brown, moist to wet, high plasticity fines, very soft.
SP/SM	(14.5 to 16.3) Silty SAND and poorly graded SAND, brown, gray below 15.6, very fine to fine-grained sand with ~ 10% to 20% silt above 15.6, moderate chemical odor where gray.
CH	(16.3 to 17.9) Sandy CLAY, reddish-brown, moist (wet on thin sand interbeds), ~ 80% to 90% high plasticity clay, soft, firm at 17.2 to 17.9.
SP	(17.9 to 20.0) Poorly graded sand, brown, wet, very fine to fine-grained sand, soft.

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Well Materials

(0.0 to 6.0) Casing, 2" sch. 40 PVC
(6.0 to 16.0) Screen, 2" sch. 40 PVC, 0.01 slot
(16.0 to 16.5) End Cap

Annular Materials

(0.0 to 3.0) Portland Cement with ~ 5% bentonite gel
(3.0 to 5.0) Bentonite chips, 3/8"
(5.0 to 16.5.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

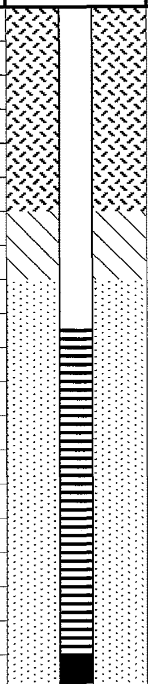
PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: SB4MW07

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/20/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	20
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554065.21
Drilling Method:	Hollow Stem Auger	Easting:	3154818.19
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	4.6
		TOC Elev. (ft MSL)	7.57

Well Construction Diagram



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)
0		
	1.3	
		4/5
	153	
5	11.6	
	7.9	5/5
	5.9	
10		
	5.2	
	6.1	5/5
	8.1	
15	8.1	
	1.8	5/5
20	2	
25		
30		

USCS	Lithologic Description
Fill	(0.0 to 4.0) FILL, sand, gravel, and clay, black-stained sand and gravel at 3.0 to 4.0 with moderate hydrocarbon odor.
CL	(5.0 to 11.0) CLAY, reddish-brown to gray, moist, medium plasticity, becomes silty clay below ~ 10.0.
CH	(11.0 to 18.9) Silty sandy CLAY, gray to brown, wet, ~ 10 to 20 % fine-grained sand, ~ 80% to 90% high plasticity clay, soft.
CL	(18.9 to 20.0) Silty CLAY, gray, moist, low to medium plasticity clay and silt, very stiff, first confining layer.

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Well Materials
(0.0 to 9.5) Casing, 2" sch. 40 PVC
(9.5 to 19.5) Screen, 2" sch. 40 PVC, 0.01 slot
(19.5 to 20.0) End Cap

Annular Materials
(0.0 to 6.0) Portland Cement with ~ 5% bentonite gel
(6.0 to 8.0) Bentonite chips, 3/8"
(8.0 to 20.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
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Log of Boring: SE1MW08

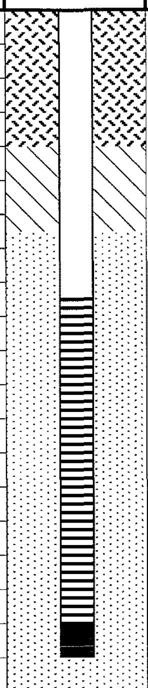
Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/19/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	20
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554391.06
Drilling Method:	Hollow Stem Auger	Easting:	3154820.14
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	4.4
		TOC Elev. (ft MSL)	7.54

Depth (ft): 0, 5, 10, 15, 20, 25, 30

Well Construction Diagram



PID (ppm-v)	Recovery (ft/ft)
5	
3.4	5/5
0.3	
3.3	
	5/5
2.7	
2.3	
1.3	5/5
3	
3.5	5/5
1.9	

USCS	Lithologic Description
Fill	(0.0 to 0.8) FILL, sand, gravel, and clay, hard.
CL	(0.8 to 8.4) Sandy CLAY, brown to reddish-brown, moist, ~ 20% fine-grained sand and carbonate nodules, ~ 80% medium plasticity clay, firm to stiff, possible fill at 0.8 to 4.0.
SM/SP	(8.4 to 11.7) Silty clayey SAND, brown to gray, moist, wet below ~ 9.0, ~ 50% high plasticity fines, ~ 50% very fine to fine-grained sand, soft.
SM	(11.7 to 16.6) Silty SAND, brown, wet, ~20% to 30% fines, ~ 70% to 80% very fine to fine-grained sand, soft.
SM/SP	(16.6 to 18.6) Silty Clayey SAND, brown, wet, ~ 50% high plasticity fines, ~ 50% fine-grained sand, soft.
CH	(18.6 to 20.0) Silty CLAY, brown to dark grayish-brown, moist, high plasticity fines, firm, first confining clay.

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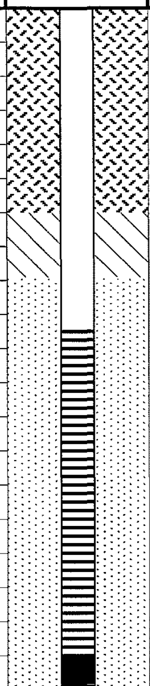
Well Materials
(0.0 to 8.5) Casing, 2" sch. 40 PVC
(8.5 to 18.5) Screen, 2" sch. 40 PVC, 0.01 slot
(18.5 to 19.0) End Cap

Annular Materials
(0.0 to 4.0) Portland Cement with ~ 5% bentonite gel
(4.0 to 6.5) Bentonite chips, 3/8"
(6.5 to 20.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: SE6MW09			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	07/20/06	Borehole Diameter (in.):	8.25
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	20
	Field Supervisor:	Tim Jennings, P.G.	Northing:	13554149.98
	Drilling Method:	Hollow Stem Auger	Easting:	3155180.49
PBW Project No. 1352	Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	4.7
			TOC Elev. (ft MSL)	7.66



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0	2.8 20.1	3.5/5	Fill	(0.0 to 2.4) FILL, sand, gravel, and clay, brown, moist to dry, very hard, abundant roots.
			SP	(2.4 to 5.2) Poorly graded SAND, dark brown, moist, trace black staining at 2.4 to 2.6, fine-grained sand, soft.
5	6.3 1.5 1.7	5/5	CL	(5.2 to 9.5) Silty CLAY, brown, moist, medium plasticity fines, stiff, increased moisture and softer below 8.0.
10	1.9 1.8	5/5	SM/SC	(9.5 to 13.0) Silty clayey SAND, brown, wet, ~ 40 to 50% high plasticity fines, ~ 50% to 60% very fine to fine-grained sand, soft.
15	1.8 1.8 2.2	5/5	SM	(13.0 to 17.9) Silty SAND, poorly graded sand, interbedded, brown, wet, ~ 20% to 40% high plasticity fines, ~ 60% to 80% very fine to fine-grained sand, very soft.
	1.5		SM/SC	(17.9 to 19.4) Silty clayey SAND, brown, wet, ~ 50% high plasticity fines, ~ 50% very fine to fine-grained sand and sand interbeds, soft.
20			CL	(19.4 to 20.0) Silty CLAY, grayish-brown, moist, high plasticity fines, very firm.
25				
30				

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Well Materials
(0.0 to 9.5) Casing, 2" sch. 40 PVC
(9.5 to 19.5) Screen, 2" sch. 40 PVC, 0.01 slot
(19.5 to 20.0) End Cap

Annular Materials
(0.0 to 6.0) Portland Cement with ~ 5% bentonite gel
(6.0 to 7.9) Bentonite chips, 3/8"
(7.9 to 20.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
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Log of Boring: SF5MW10

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/20/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	20
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554284.4
Drilling Method:	Hollow Stem Auger	Easting:	3155154.1
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	5
		TOC Elev. (ft MSL)	8.01

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0		4/5	SM/SC	(0.0 to 1.3) Silty clayey SAND, brown, moist, ~ 50% low plasticity fines, ~ 50% fine-grained sand, firm, abundant roots.
	1.5		CL	(1.3 to 2.5) Silty CLAY, brown to gray, moist, low plasticity fines, stiff.
	2.4		SM	(2.5 to 5.0) Silty SAND, brown to black, moist, ~ 40% low plasticity fines, ~ 60% fine-grained sand, black staining has slight hydrocarbon odor.
5	1.5, 1.7	5/5	CL	(5.0 to 8.6) Silty sandy CLAY, reddish brown, moist, ~ 10% to 20% fine-grained sand and silt, ~ 80% to 90% medium plasticity clay, firm, stiff.
	1.7		SM/SC	(8.6 to 10.5) Silty clayey SAND, brown, moist, ~ 50% high plasticity fines, ~ 50% very fine-grained sand, very soft.
10	1.7, 1.5	5/5	SM/MH/CL	(10.5 to 15.0) Interbedded silty SAND, sandy SILT, and silty clayey SAND, brown, wet, ~40% to 60% high plasticity fines as interbeds, ~ 40 to 60% very fine-grained sand, soft.
15	1.4, 1.4	5/5	SM	(15.0 to 18.2) Silty SAND, brown, wet, ~ 40% medium plasticity silt, ~60% very fine to fine-grained sand, soft.
	1.5		CH	(18.2 to 20.0) Silty CLAY, grayish-brown, moist, high plasticity fines, soft, first confining clay.
20				
25				
30				

Well Materials
(0.0 to 9.0) Casing, 2" sch. 40 PVC
(9.0 to 19.0) Screen, 2" sch. 40 PVC, 0.01 slot
(19.0 to 19.5) End Cap

Annular Materials
(0.0 to 5.0) Portland Cement with ~ 5% bentonite gel
(5.0 to 7.0) Bentonite chips, 3/8"
(7.0 to 20.0) Sand, 20/40 silica

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PASTOR, BEHLING & WHEELER, LLC
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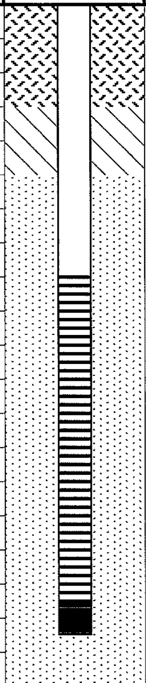
Log of Boring: SF6MW11

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/20/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	20
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554215.04
Drilling Method:	Hollow Stem Auger	Easting:	3155265.88
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	5
		TOC Elev. (ft MSL)	8.11



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0–2.5	0.1 1.6 1.5	3/5	Fill	(0.0 to 2.5) FILL, sandy clay with gravel and oyster shells, dark brown, moist, ~ 20% to 30% fine-grained sand, moist, ~ 20% to 30% fine-grained sand, ~ 15% gravel and oyster shells, ~ 70% to 80% low plasticity clay, very stiff.
2.5–9.5	1.6 1.4	5/5	CL	(2.5 to 9.5) Silty CLAY, grayish-brown, moist, ~10% silt and very fine-grained sand, ~ 90% medium plasticity clay, very stiff, firm below 8.5, few oyster shell fragments and carbonate nodules.
9.5–13.3	1.9 1.7	5/5	CL/SC	(9.5 to 13.3) Sandy silty CLAY and SAND, brown, wet, ~ 40% very fine to fine-grained sand, a few thin interbeds, ~ 60% high plasticity fines, soft.
13.3–18.0	2 2 1.8	5/5	SM	(13.3 to 18.0) Silty SAND, brown, wet, ~30% to 40% fines, ~ 60% to 70% very fine to fine-grained sand, soft.
18.0–20.0			CL	(18.0 to 20.0) Silty sandy CLAY, brown, moist, ~ 10% to 20% fine-grained sand and silt, ~ 80% to 90% medium plasticity clay, firm.

Depth scale (ft): 0, 5, 10, 15, 20, 25, 30

PBW
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Well Materials
(0.0 to 8.0) Casing, 2" sch. 40 PVC
(8.0 to 18.0) Screen, 2" sch. 40 PVC, 0.01 slot
(18.0 to 18.5) End Cap

Annular Materials
(0.0 to 3.0) Portland Cement with ~ 5% bentonite gel
(.0 to 5.0) Bentonite chips, 3/8"
(5.0 to 20.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

076959

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	# Log of Boring: SF7MW12

Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	07/20/06	Borehole Diameter (in.):	8.25
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	20
	Field Supervisor:	Tim Jennings, P.G.	Northing:	13554105.36
	Drilling Method:	Hollow Stem Auger	Easting:	3155304.07
PBW Project No. 1352	Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	4.7
			TOC Elev. (ft MSL)	7.96

Depth (ft)	Well Construction Diagram	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0		1.5		Fill	(0.0 to 1.0) FILL, poorly graded SAND, brown, moist, very fine to fine-grained sand.
		21.4	4/5		(1.0 to 5.0) FILL, sand, clay, gravel and shells, stiff, dark brown to black with moderate chemical odor locally near 2.0 to 3.0.
		1.8			
5		2.6	2.5/5	CL	(5.0 to 10.0) Silty sandy CLAY, dark brown to gray, moist, ~5% to 10% very fine-grained sand and silt, ~ 90% to 95% medium plasticity clay, stiff.
10		1.9		SM/SC	(10.0 to 14.5) Silty SAND and clayey SAND, grayish-brown and brown, wet, ~ 30% high plasticity clay as clayey sand interbeds, ~ 20% low plasticity silt, ~ 50% very fine to fine-grained sand, soft.
		1.6	5/5		
15		1.9		SP	(14.5 to 18.0) Poorly graded SAND with silt, brown, wet, < 10% low plasticity fines, > 90% very fine to fine-grained sand, very soft.
		1.7	5/5		
				SP/SM/SC	(18.0 to 19.0) Interbedded, poorly graded SAND and silty clayey SAND, brown, wet, ~ 50% low plasticity fines, ~ 50% very fine to fine-grained sand, soft.
		1.8		CL	(19.0 to 20.0) Silty CLAY, grayish-brown, moist, high plasticity fines, very firm, first confining clay.
20					
25					
30					

PBW

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Well Materials

(0.0 to 8.5) Casing, 2" sch. 40 PVC
(8.5 to 18.5) Screen, 2" sch. 40 PVC, 0.01 slot
(18.5 to 19.0) End Cap

Annular Materials

(0.0 to 5.0) Portland Cement with ~ 5% bentonite gel
(5.0 to 7.0) Bentonite chips, 3/8"
(7.0 to 20.0) Sand, 20/40 silica

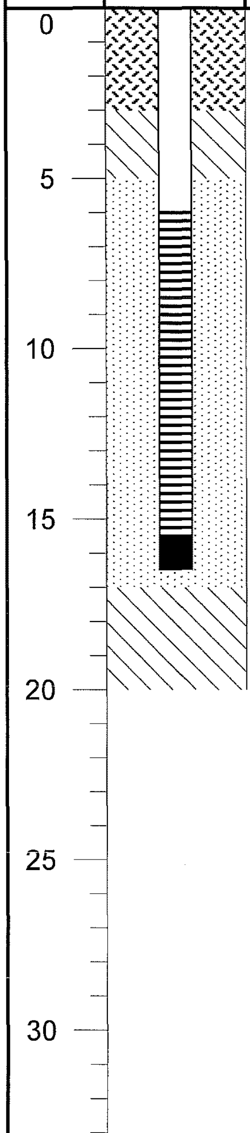
This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: SG2MW13

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/19/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	22
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554472.65
Drilling Method:	Hollow Stem Auger	Easting:	3155012.01
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	4.5
		TOC Elev. (ft MSL)	7.71



PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
1.4		Fill	(0.0 TO 2.1) FILL, sand, gravel, and clay, firm, soft.
11.1	3.5/5	SP	(2.1 to 3.0) FILL, sand, brown, moist.
3.4 4.6 4 5.8	5/5	CL/CH	(3.0 to 11.2) Sandy silty CLAY, reddish-brown to gray, moist, ~ 20% to 30% fine-grained sand and silt, ~ 70% to 80% medium to high plasticity clay, firm.
4.9 5.3 5.3	5/5	SP/SM/CL	(11.2 to 16.0) Interbedded SAND, silty SAND, and sandy CLAY, brown, wet, ~ 50% to 60% poorly graded fine-grained sand interbeds (0.5 inches thick), locally very silty, ~ 40% to 50% high plasticity clay as interbeds.
3.2 4.4	5/5	CH	(16.0 to 18.2) CLAY, reddish-brown to brown, moist, high plasticity clay, first confining clay.
		CH/SP/SC	(18.2 to 20.0) CLAY as above, with ~ 45% shell-derived sand (ground oyster shells) interbeds, bronw, wet.
5.2	2/2	SP	(20.0 to 22.0) Shell-derived SAND, brown, fine to coarse-grained, wet.

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Well Materials
(0.0 to 6.0) Casing, 2" sch. 40 PVC
(6.0 to 16.0) Screen, 2" sch. 40 PVC, 0.01 slot
(16.0 to 16.5) End Cap

Annular Materials
(0.0 to 3.0) Portland Cement with ~ 5% bentonite gel
(3.0 to 5.0) Bentonite chips, 3/8"
(5.0 to 17.0) Sand, 20/40 silica
(17.0 to 20.0) Bentonite chips, 3/8"

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

Log of Boring: SH7MW14

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/19/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	22
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554264.46
Drilling Method:	Hollow Stem Auger	Easting:	3155446.95
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	5.2
		TOC Elev. (ft MSL)	8.1

Depth (ft)	Well Construction Diagram	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0			0.5/5	Fill	(0.0 to 1.0) SAND and GRAVEL, very poor recovery, very hard road base material.
5		11.7, 12.7, 10.8	5/5	CL	(1.0 to 11.4) Sandy CLAY, grayish-brown, moist, ~ 10% to 20% fine-grained sand, ~ 80% to 90% medium plasticity clay, soft.
10		10.7, 11.9, 10.4	5/5	SP	(11.4 to 13.0) Poorly graded SAND, brown, wet, very fine-grained to fine-grained, soft.
15		11.5, 10.7	5/5	SP/SM/SC	(13.0 to 19.4) Poorly graded SAND with silty sand and clayey sand, brown, wet, ~ 60 to 90% very fine-grained sand, ~ 10 to 40% high plasticity fines, soft.
20		12.1	2/2	CH	(19.4 to 22.0) Sandy CLAY, brown to gray, moist, ~ 20% fine-grained sand beds, ~ 80% high plasticity clay, firm, borehole allowed to slough in to 21.0 for well construction.
25					
30					

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Well Materials
(0.0 to 10.0) Casing, 2" sch. 40 PVC
(10.0 to 20.0) Screen, 2" sch. 40 PVC, 0.01 slot
(20.5 to 21.0) End Cap

Annular Materials
(0.0 to 6.0) Portland Cement with ~ 5% bentonite gel
(6.0 to 8.0) Bentonite chips, 3/8"
(8.0 to 21.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
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Log of Boring: SJ1MW15

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/19/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	25
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554764.11
Drilling Method:	Hollow Stem Auger	Easting:	3155165.2
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	2.5
		TOC Elev. (ft MSL)	5.61

Depth (ft)	Well Construction Diagram	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0		3.4 3.9	3/5	CL	(0.0 to 1.0) Sandy CLAY, brown, moist, ~ 40% fine to medium-grained sand, ~ 60% low plasticity clay, soft.
5		5.9 7.3 6.9	4/5		(1.0 to 7.5) Sandy CLAY, reddish-brown to gray, moist, ~ 10% fine-grained sand and silt, ~ 90% medium plasticity clay.
10		5.9 5.5	4.5/5	SP/SM	(7.5 to 20.0) Silty Clayey SAND, brown, moist to wet below 10.0, ~ 20% to 40% high plasticity fines as interbeds, ~ 60% to 80% very fine to fine-grained sand with poorly graded sand interbeds at 11.5 to 12.5 and 13.2 to 15.0, soft.
15		7.3 8.4 7.5	5/5		
20		5.9 9.2	5/5	CH	(20.0 to 23.7) Silty CLAY, gray, moist, high plasticity, firm, first confining clay.
		10.8		SP	(23.7 to 25.0) Poorly graded SAND, brown, wet, very fine to fine-grained sand, soft, borehole allowed to slough in to 24.0 for well construction.
25					
30					

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Well Materials

(0.0 to 10.0) Casing, 2" sch. 40 PVC
(10.0 to 20.0) Screen, 2" sch. 40 PVC, 0.01 slot
(20.5 to 20.5) End Cap

Annular Materials

(0.0 to 5.5) Portland Cement with ~ 5% bentonite gel
(5.5 to 7.5) Bentonite chips, 3/8"
(7.5 to 21.0) Sand, 20/40 silica
(21.0 to 24.0) Bentonite chips, 3/8"

This boring log should not be used separately from the original report.

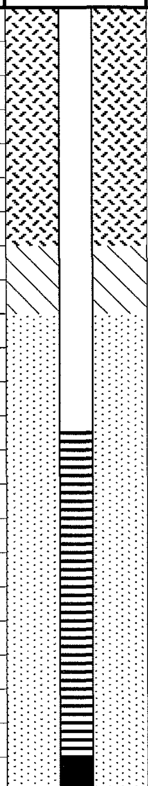
PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: SJ7MW16

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/18/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	25
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554383.75
Drilling Method:	Hollow Stem Auger	Easting:	3155635.14
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	4.7
		TOC Elev. (ft MSL)	7.19

Well Construction Diagram



Depth (ft)	PID (ppm-v)
~1	0
~3	0
~5.5	0.3
~7	0.2
~8.5	0.2
~10.5	0
~12.5	0.1
~15.5	0.1
~17	0.1
~18.5	0.4
~20.5	1.9
~22	1.5
~23.5	2.3

Depth interval (ft)	Recovery (ft/ft)
0 to 5	5/5
5 to 10	5/5
10 to 15	5/5
15 to 20	5/5
20 to 25	5/5

USCS	Lithologic Description
Fill	(0.0 to 2.0) FILL, crushed shell.
Fill	(2.0 to 3.4) FILL, sandy gravelly clay with brick fragments, abundant roots, moist.
CL	(3.4 to 10.2) Sandy CLAY and CLAY, brown, mottled dark reddish-brown and gray, moist, ~ 10% to 20% fine to medium-grained sand, ~ 80% to 90% medium to high plasticity clay, very firm, interbedded poorly graded sand at 4.6 to 5.0.
SM	(10.2 to 11.4) Silty SAND, brown, wet, ~ 30% to 40% fines, ~ 60% to 70% fine-grained sand.
SP	(11.4 to 17.0) Poorly graded SAND, brown, wet, fine-grained, soft.
SC	(17.0 to 18.5) Clayey SAND, brown, wet, ~ 50% high plasticity clay, ~ 50% fine-grained sand, very soft.
SP	(18.5 to 21.9) Poorly graded SAND, brown, wet, very fine-grained, thin (< 0.2 inches) sandy clay interbeds locally, very soft.
CH	(21.9 to 25.0) Sandy CLAY, dark grayish-brown, moist, ~ 20% fine-grained sand, ~ 80% high plasticity clay, few interbedded sands at 21.9 to 22.5, soft, borehole allowed to slough in to 23.0 for well construction.

PBW
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Well Materials
(0.0 to 12.5) Casing, 2" sch. 40 PVC
(12.5 to 22.5) Screen, 2" sch. 40 PVC, 0.01 slot
(22.5 to 23.0) End Cap

Annular Materials
(0.0 to 7.0) Portland Cement with ~ 5% bentonite gel
(7.0 to 9.0) Bentonite chips, 3/8"
(9.0 to 23.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

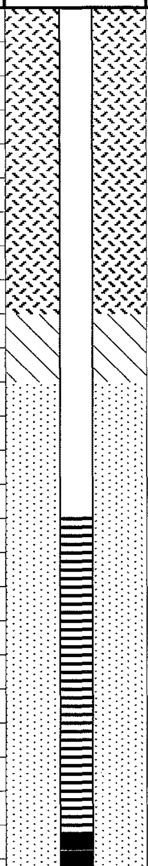
Log of Boring: SL8MW17

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/18/06	Borehole Diameter (in.):	8.25
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	33
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554520.95
Drilling Method:	Hollow Stem Auger	Easting:	3155809.04
Sampling Method:	5 ft continuous core	Ground Elev. (ft. MSL):	2.9
		TOC Elev. (ft MSL)	5.87

Well Construction Diagram



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0	0, 6.8	4/5	CL	(0.0 to 0.5) Sandy CLAY, brown, moist, ~ 30% fine-grained sand, ~70% medium plasticity CLAY, < 5% oyster shell fragments, soft.
			SP	(0.5 to 2.5) SAND and clayey SAND, brown, moist, ~ 30% to 40% medium to high plasticity clay, ~ 60% to 70% very fine to fine-grained sand, < 5% oyster shell fragments, soft.
			CL	(2.5 to 4.0) Poorly graded SAND, brown, moist, very fine-grained, soft.
5	0, 8.7	3.25/5		(4.0 to 5.0) Sandy CLAY, brown, moist, ~ 30% fine-grained sand, ~70% clay.
10	5.6, 7.2	3.5/5	CH	(5.0 to 11.3) Sandy CLAY, brown, moist, ~ 30%, fine-grained sand, ~70% high plasticity clay, ~ 10% thin sand interbeds.
			SP/SM	(11.3 to 15.0) Poorly graded SAND and SILT, brown, wet, very fine-grained sand, soft, ~ 20% to 30% high plasticity fines.
15	2.3	2/5	SP	(15.0-30.0) SAND as above with decreassing silt content below 15.0.
20	42.8, 36.4	5/5		
25	38.2, 40.1	3.5/5		
30	50, 52.6	3/3	CL	(30.0 to 33.0) Sandy CLAY, mottled gray and brown, moist, ~ 10% to 20% fine-grained sand, ~ 80% to 90% medium plasticity clay, very firm, abundant carbonate nodules.

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Well Materials
- (0.0 to 15.0) Casing, 2" sch. 40 PVC
- (15.0 to 25.0) Screen, 2" sch. 40 PVC, 0.01 slot
- (25.0 to 25.3) End Cap

Annular Materials
- (0.0 to 9.0) Portland Cement with ~ 5% bentonite gel
- (9.0 to 11.0) Bentonite chips, 3/8"
- (11.0 to 25.3) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

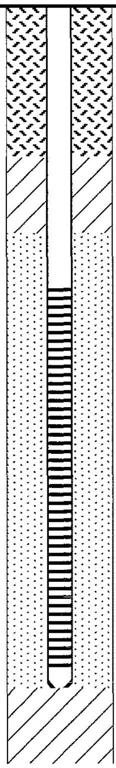
Log of Boring: NB4MW18

Gulfco Marine Maintenance Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	05/30/07	Borehole Diameter (in.):	8.25
Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	19
Field Supervisor:	Len Mason, PG	Northing:	13554255.42
Drilling Method:	Hollow Stem Auger	Easting:	3154474.18
Sampling Method:	5 ft. split spoon	Ground Elev. (ft. MSL):	2.5
		TOC Elev. (ft MSL)	4.96

Depth (ft)	Well Construction Diagram	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description



Depth (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

PID (ppm-v): 0.0, 0.4, 0.2, 0.3, 0.2, 0.4, 0.5, 0.5, 0.5

Recovery (ft/ft): 4/5, 5/5, 5/5, 2/2, 2/2

USCS	Lithologic Description
SC/SM	(0.0 to 0.4) Clayey silty SAND, brown, slightly moist, very fine-grained quartz, crumbly, some vegetation throughout.
CH	(0.4 to 12.2) CLAY, brown, dark brown, and some blackish-brown, moist, high plasticity, slightly firm, root fibers in top 2 feet, at 2.5 feet becoming gray and brown/strong brown, mottled, moisture content increasing, 5 feet to 6.9 feet has some areas of saturation, mostly reddish-brown with some gray mottling at 6.9 feet, becomes gray at 8.9 feet.
ML	(12.2 to 17.9) Slightly sandy clayey SILT, mostly gray with some reddish-brown, saturated, ~20% clay, ~ 5-10% very fine-grained sand, soft, thin shell fragment layer at 12.3 feet.
CH	(17.9 to 20.0) Silty CLAY, gray with some olive-gray, slightly mottled, slightly moist, high plasticity, firm.

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Well Materials
(0.0 to 7.5) Casing, 2" sch. 40 PVC
(7.5 to 17.5) Screen, 2" sch. 40 PVC, 0.01 slot
(17.5 to 18.0) End Cap

Annular Materials
(0.0 to 4.0) Portland Cement with 5% bentonite gel
(4.0 to 6.0) Bentonite chips, 3/8"
(6.0 to 18.0) Sand, 20/40 silica
(18.0 to 20.0) Coated bentonite pellets

This boring log should not be used separately from the original report.

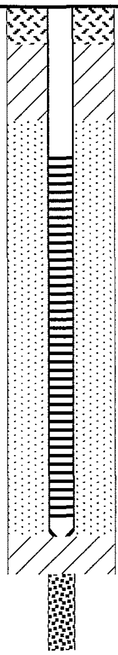
PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

Log of Boring: NG3MW19

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	05/23/07	Borehole Diameter (in.):	8.25
Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	17
Field Supervisor:	Tim Jennings, PG	Northing:	13555039.92
Drilling Method:	Hollow Stem Auger	Easting:	3154974.73
Sampling Method:	5 ft. split spoon	Ground Elev. (ft. MSL):	2.2
		TOC Elev. (ft MSL)	5.08

Depth (ft)	Well Construction Diagram	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0 – 0.4		0.1	4/5	SP	(0.0 to 0.4) Clayey SAND, brown, moist, ~ 20% low plasticity fines, 80% fine to medium-grained sand, soft.
0.4 – 7.5		0.0, 0.4	4/5, 0/5	CL	(0.4 to 7.5) Sandy CLAY, gray 0.4 - 1.4 feet becoming reddish brown with gray mottling below, moist, ~ 10-20% very fine to fine-grained sand, ~ 80-90% medium plasticity clays, firm to soft, few oxidized iron nodules, becomes saturated below 4 feet.
7.5 – 12.0		0.6, 0.2	0/5, 5/5	SP	(7.5 to 12.0) Silty clayey SAND, brown, wet, ~ 20-50% low plasticity fines, ~ 70-80% very fine to fine-grained sand, very soft, increasing clay content below 11 feet, grades into sandy clay at 12 feet.
12.0 – 16.1		0.1, 0.0	5/5, 2/5	CL	(12.0 to 16.1) Sandy CLAY, grayish brown, wet, ~10-20% fine-grained sand, ~ 80% medium plasticity clay, very soft.
16.1 – 17.0			2/5	SP	(16.1 to 17.0) SAND, poorly graded, brown, wet, fine to medium-grained, abundant shell fragments, soft.

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

PBW

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<u>Well Materials</u>
(0.0 to 4.0) Casing, 2" sch. 40 PVC
(4.0 to 13.5) Screen, 2" sch. 40 PVC, 0.01 slot
(13.5 to 14.0) End Cap

<u>Annular Materials</u>
(0.0-1.0) Potland Cement with 5% bentonite gel
(1.0-3.0) Bentonite chips, 3/8"
(3.0-14.0) Sand, 20/40 silica
(14.0-15.0) Coated bentonite pellets

2" borehole caved in from 15-17'

This boring log should not be used separately from the original report.

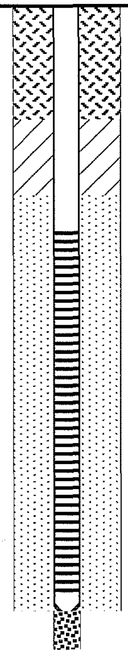
PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

Log of Boring: OMW20

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	05/24/07	Borehole Diameter (in.):	8.25
Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	17.5
Field Supervisor:	Tim Jennings, PG	Northing:	13554952.64
Drilling Method:	Hollow Stem Auger	Easting:	3154011.31
Sampling Method:	5 ft. split spoon	Ground Elev. (ft. MSL):	1.6
		TOC Elev. (ft MSL)	4.88



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0	0.0	5/5	CL	(0.0 to 0.8) Silty sandy CLAY dark gray, wet, ~ 20% silt and very fine sand, ~ 80% medium plasticity clay, soft, abundant roots, abundant organic matter.
2	0.0			
4	0.0		CL	(0.8 to 7.5) Sandy CLAY, reddish-brown with gray mottling, moist, ~ 10% fine sand, ~ 90% medium plasticity clay, firm, few oxidized iron nodules.
6	0.0	4/5		
8			CL	(7.5 to 10.0) Sandy CLAY, gray with reddish-brown mottling, moist, ~ 10 -20% fine sand, ~ 80% medium plasticity clay, firm to soft.
10	0.1	5/5	CL	(10.0 to 12.4) Silty CLAY, reddish brown, wet, < 20% low plasticity silt, > 80% high plasticity clay, soft, a few small carbonate concretions.
12	0.2		CL	(12.4 to 13.6) Silty CLAY, gray, wet, ~ 50 % silt, ~ 50% medium plasticity clay, very soft.
14	0.2		CL	(13.6 to 15.2) Silty CLAY, reddish-brown with gray mottling, moist, ~ 20% silt and very fine sand, ~ 80% medium plasticity clay, soft.
16	0.2	2.5/2.5	CL	(15.2 to 17.5) CLAY, gray, moist, low plasticity, friable, a few iron nodules, firm.
18				
20				
22				
24				
26				
28				
30				

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<u>Well Materials</u>
(0.0 to 6.0) Casing, 2" sch. 40 PVC
(6.0 to 15.5) Screen, 2" sch. 40 PVC, 0.01 slot
(15.5 to 16.0) End Cap

<u>Annular Materials</u>
(0.0 to 3.0) Portland Cement with 5% bentonite gel
(3.0 to 5.0) Bentonite chips, 3/8"
(5.0 to 16.0) Sand, 20/40 silica

2" borehole caved in from 16-17.5'

This boring log should not be used separately from the original report.

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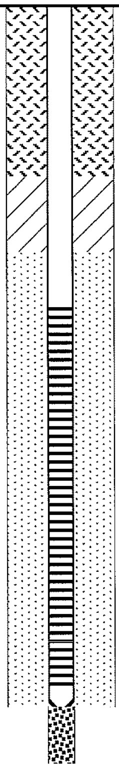
Log of Boring: OMW21

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	05/21/07	Borehole Diameter (in.):	8.25
Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	20
Field Supervisor:	Tim Jennings, PG	Northing:	13555272.78
Drilling Method:	Hollow Stem Auger	Easting:	3154248.25
Sampling Method:	5 ft. split spoon	Ground Elev. (ft. MSL):	2.4
		TOC Elev. (ft MSL)	5.73



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0	0.0	5/5	CL	(0.0 to 1.4) Sandy CLAY, dark brown, moist, ~ 10-20% very fine-grained sand, ~ 80-90% medium plasticity clays.
2				
4	0.0		CL	(1.4 to 10.0) Silty CLAY, reddish-brown, moist, medium plasticity, firm to soft, reddish-brown with gray mottling below 4 feet, becomes gray with reddish-brown mottling below 5.7 feet, wet below 8.2 feet.
6	0.0	4/5		
8	0.0			
10	0.0	1/5	CL	(10.0 to 18.8) Sandy, silty, CLAY, gray, wet, ~ 10-20% very fine-grained sand, ~ 80-90% medium plasticity clay, a few shell fragments, very soft. Shell fragments and sand content increasing by 15 feet, light gray, ~ 10-20% shell fragments, ~ 30-40% fine to medium-grained sand, ~ 50-60% medium plasticity clay. Sand content decreasing at 17.5 feet, grayish brown, ~ 5% oyster fragments, ~ 10% very fine-grained sand, ~ 85% medium plasticity clay, firm, base of saturation between 16.3 and 17.5 feet.
12				
14	0.0			
16	0.1	1.25/2.5		
18		2.5/2.5	CL	(18.8 to 20.0) Silty CLAY, gray, moist, ~ 40-50% silt, ~ 50-60% low plasticity clay, firm.
20				
22				
24				
26				
28				
30				

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Well Materials

(0.0 to 8.0) Casing, 2" sch. 40 PVC
(8.0 to 18) Screen, 2" sch. 40 PVC, 0.01 slot
(18 to 18.5) End Cap

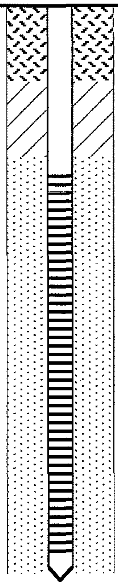
Annular Materials

(0.0 to 4.5) Portland Cement with 5% bentonite gel
(4.5 to 6.5) Bentonite chips, 3/8"
(6.5 to 18.5) Sand, 20/40 silica

2" borehole caved in from 18.5-20"

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: SA4MW22			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	05/30/07	Borehole Diameter (in.):	8.25
	Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	15
	Field Supervisor:	Len Mason, PG	Northing:	13553934.09
PBW Project No. 1352	Drilling Method:	Hollow Stem Auger	Easting:	3154726.12
	Sampling Method:	5 ft. split spoon	Ground Elev. (ft. MSL):	5.5
			TOC Elev. (ft MSL)	7.79



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0–3.1		4.9/5 (0–5)	SC-SW	(0.0-3.1) Silty clayey SAND, reddish-brown, dry, ~ 5-10% low plasticity clay, mostly fine-grained sand with some medium-grained, some root material, subrounded, loose, clay content increasing at 2.2 feet to ~ 20-30%, some gravel and shell fragments, becoming slightly moist, decayed plant material at 3.0 to 3.1 feet.
3.1–4.4			SM	(3.1 to 4.4) Clayey silty SAND, grayish-brown, slightly moist, ~ 10% clay, ~ 30% silt, ~ 60% very fine-grained, subrounded sand.
4.4–5.0	0.4 (5.0)		CH	(4.4 to 5.0) CLAY, dark gray to grayish-black, dry slightly moist, medium plasticity, firm.
5.0–8.1	0.3 (7.0)	5/5 (5–10)	SM/SC	(5.0 to 8.1) Clayey silty SAND, grayish-brown, moist, ~ 30% clay and silt, ~ 70% subrounded fine-grained sand, some clay lenses throughout, becoming saturated at 6 feet, increasingly clayey at 7.1 feet.
8.1–15.0	0.6 (9.0) 0.3 (11.0) 0.6 (13.0)	4.9/5 (10–15)	CH	(8.1 to 15.0) Slightly silty CLAY, reddish-brown with some gray, very moist, high plasticity clay, soft becomes mostly gray with some reddish brown at 12 feet, some decayed vegetation.

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

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Well Materials

(0.0 to 4.5) Casing, 2" sch. 40 PVC
(4.5 to 14.5) Screen, 2" sch. 40 PVC, 0.01 slot
(14.5 to 15.0) End Cap

Annular Materials

(0.0 to 2.0) Portland Cement with 5% bentonite gel
(2.0 to 4.0) Bentonite chips, 3/8"
(4.0 to 15.0) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

Log of Boring: NC2B23B

Gulfco Marine Maintenance Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	05/31/07	Borehole Diameter (in.):	12/8.25
Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	40
Field Supervisor:	Tim Jennings, PG	Northing:	13554659.58
Drilling Method:	Hollow Stem Auger	Easting:	3154227.19
Sampling Method:	5 ft split spoon	Ground Elev. (ft. MSL):	2.0
		TOC Elev. (ft MSL)	2.37

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0.0–0.7			CL	(0.0 to 0.7) Sandy CLAY, dark gray, wet, ~ 10% fine sand, ~ 90% medium plasticity clay, soft, abundant roots.
0.7–12.6			CL	(0.7 to 12.6) Sandy CLAY with silt, reddish-brown with gray mottling, moist to locally wet, ~ 10-20% very fine-grained sand, ~ 80-90% medium plasticity clay, firm and locally friable, gray mottling increasing below 4.5 feet, brown organic matter from 8 to 8.5 feet, no odor, becoming wet at 10 feet, a few small sand lenses from 12 to 12.6 feet.
12.6–14.1			CL/SP	(12.6 to 14.1) Sandy silty CLAY and SAND, gray, wet, ~ 20-30% fine-grained sand, ~ 20-30% silt, ~ 50% medium plasticity, a few oyster shells thin (< 0.1") sand interbeds.
14.1–15.0	0.0		CL	(14.1 to 15.0) Silty CLAY, reddish-brown with gray mottling, moist, ~ 10-20% silt, ~ 80-90% medium plasticity clay, firm.
15.0–17.3	0.0	3/5	CL	(15.0 to 17.3) Silty sandy CLAY, gray, moist to locally wet, ~ 10-15% very fine-grained sand and silt, ~ 85-90% medium plasticity clay, very soft, very silty (wet at 15 to 15.7 feet and at 16.3 feet).
17.3–23.1	0.0, 0.0	5/5	CL	(17.3 to 23.1) Silty CLAY, greenish-gray (olive), moist, < 10% silt, ~ 90% medium plasticity clay, stiff, zone of carbonate nodules at 21.5 and 22.2 feet.
23.1–26.4	0.0, 0.0		CL	(23.1 to 26.4) Silty CLAY, reddish brown with gray mottling, moist, ~ 20-30% silt, ~ 70-80% medium plasticity clay, soft and friable.
26.4–35.3	0.0, 0.5, 0.2, 0.0	5/5, 5/5	CL	(26.4 to 35.3) Silty sandy CLAY greenish gray with brown mottling, moist, ~ 10-20% silt, ~ 5% fine-grained sand, ~ 80-90% medium plasticity clay, very firm, locally fractured, ~ 2-inch thick lens of poorly graded, fine-grained, gray sand at 27.8 to 28 feet, becoming brown to reddish-brown with gray mottling below 30 feet, abundant carbonate nodules locally from 30 to 32 feet.
35.3–40.0	0.0	5/5	CH	(35.3 to 40.0) CLAY, reddish-brown with gray mottling, moist, medium plasticity, very stiff, fat clay.

Note: Portland Cement with 5% bentonite gel placed in the annular space outside of the surface casing (0.0 to 15.0 foot

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Well Materials
(0.0 to 15.0) Surface Casing, 8" sch. 40 PVC

Annular Materials
(15.0 to 40.0) Portland Cement with 5% bentonite gel

Lithologic description for 0 to 15 foot depth interval from NC2MW28 boring

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	# Log of Boring: ND4MW24B

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	05/29/07	Borehole Diameter (in.):	12/8.25
Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	34
Field Supervisor:	Len Mason, PG	Northing:	13554569.19
Drilling Method:	Hollow Stem Auger	Easting:	3154749.48
Sampling Method:	5 ft split spoon	Ground Elev. (ft. MSL):	3.5
		TOC Elev. (ft MSL)	5.7

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0.0–0.2			CL	(0.0 to 0.2) Silty SAND, light brown, moist, very fine-grained sand, soft.
0.2–0.6			CL	(0.2 to 0.6) Sandy CLAY, dark brown, moist, ~ 20% very fine-grained sand, ~ 80% medium plasticity clay, slightly firm.
0.6–2.0			CL	(0.6 to 2.0) Sandy CLAY, dark brown, becomes black below 1.5 feet.
2.0–4.2			CL	(2.0 to 4.2) Sandy CLAY, locally black and dark reddish-brown, becomes highly plastic below ~ 3.0.
4.2–8.2			CL	(4.2 to 8.2) Sandy CLAY as above, reddish-brown, moist, wet below 5.9 feet, with thin sand interbeds locally.
8.2–10.4			CL	(8.2 to 10.4) Sandy CLAY, brown, wet, ~ 40% very fine-grained sand, ~ 60% highly plastic clay, soft.
10.4–15.6			SP	(10.4 to 15.6) Poorly graded SAND with clayey sand, brown, wet, ~ 80% fine-grained sand, ~ 20% high plasticity clay, very soft.
15.6–17.0			CL/SP	(15.6 to 17.0) Poorly graded SAND and sandy CLAY, brown, wet, ~ 50% very fine-grained sand, ~ 50% high plasticity clay, very soft.
17.0–19.0	1.3		CH	(17.0 to 19.0) Sandy CLAY, brown to grayish brown, wet, <5% fine-grained sand, ~95% high plasticity CLAY, soft.
19.0–20.5		4/5	CL	(19.0 to 20.5) Silty CLAY with some very fine-grained sand, gray to brownish-gray, wet, low to medium plasticity, soft.
20.5–22.5	0.8		SM	(20.5 to 22.5) Silty SAND, brown to brownish-gray, wet, sand is fine-grained with some medium sized grains, loose.
22.5–24.0	0.8		CH	(22.5 to 24.0) Grades into a silty CLAY with trace sand, brown to gray, wet, high plasticity, soft.
24.0–34.0	0.3, 0.1	5/5	CH	(24.0 to 34.0) Slightly silty CLAY with some trace sand, brown to gray, wet, high plasticity, becoming slightly firm to stiff at 29 feet.
	0.1, 0.3, 0.4	4/5		*Note: Portland Cement with 5% bentonite gel placed in the annular space outside of the surface casing (0.0 to 19.0 foot depth interval).*

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Well Materials
(0.0 to 19.0) Surface Casing, 8" sch. 40 PVC
(0.0 to 21.5) Casing, 2" sch. 40 PVC
(21.5 to 26.5) Screen, 2" sch. 40 PVC, 0.01 slot
(26.5 to 27.0) End Cap

Annular Materials
(0.0 to 17.0) Portland Cement with 5% bentonite gel
(17.0 to 20.0) Bentonite chips, 3/8"
(20.0 to 27.0) Sand, 20/40 silica
(27.0 to 34.0) coated bentonite pellets

Lithologic description for 0 to 19 foot depth interval from ND4W03 boring

This boring log should not be used separately from the original report.

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Consulting Engineers and Scientists

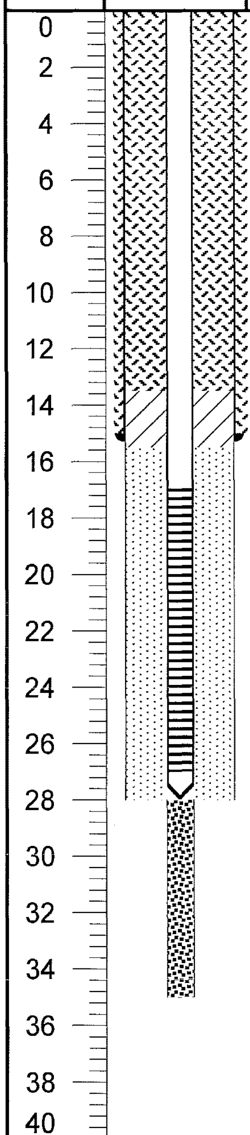
Log of Boring: NG3MW25B

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	05/30/07	Borehole Diameter (in.):	12/8.25
Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	35
Field Supervisor:	Tim Jennings, PG	Northing:	13555045.25
Drilling Method:	Hollow Stem Auger	Easting:	3154968.84
Sampling Method:	5 ft split spoon	Ground Elev. (ft. MSL):	2.2
		TOC Elev. (ft MSL)	4.91

Depth (ft) | Well Construction Diagram



PID (ppm-v)	Recovery (ft/ft)
0.1	4/4
0.9	
0.5	
0.0	
	2/5
0.0	
0.0	5/5
0.0	5/5

USCS	Lithologic Description
SP	(0.0 to 0.4) Clayey SAND, brown, moist, ~ 20% low plasticity fines, 80% fine to medium-grained sand, soft.
CL	(0.4 to 7.5) Sandy CLAY, gray 0.4 - 1.4 feet becoming reddish brown with gray mottling below, moist, ~ 10-20% very fine to fine-grained sand, ~ 80-90% medium plasticity clays, firm to soft, few oxidized iron nodules, becomes saturated below 4 feet.
SP	(7.5 to 12.0) Silty clayey SAND, brown, wet, ~ 20-50% low plasticity fines, ~ 70-80% very fine to fine-grained sand, very soft, increasing clay content below 11 feet, grades into sandy clay at 12 feet.
CL	(12.0 to 16.3) Sandy CLAY (CL), grayish brown, wet, ~10-20% fine-grained sand, ~ 80% medium plasticity clay, very soft becomes reddish-brown at 15 feet.
SP	(16.3 to 17.5) SAND, poorly graded, brown to gray, wet, sand is fine to medium-grained, poorly graded, with abundant shell fragments (~ 10%), very soft.
CL/SP	(17.5 to 18.4) Sandy CLAY with SAND, brown, wet, ~ 90% medium plasticity clay, with ~ 10% fine-grained sand as thin interbeds.
SP	(18.4 to 19.0) SAND with shell fragments.
CL	(19.0 to 19.6) CLAY, brown, wet, medium plasticity, soft, with ~ 5-10% sand lenses.
SP	(19.6 to 21.1) SAND, brown, wet, poorly graded, fine-grained, soft.
CL - SP	(21.1 to 22.7) Interbedded CLAY and SAND, brown, wet, ~ 50% poorly graded, fine-grained sand interbeds, ~ 50% medium plasticity clay, very soft.
SP	(22.7 to 32.0) SAND, brown, wet (flowing), fine-grained, ~ 30% medium plasticity clay from 28.5 to 29 feet.
CL	(32.0 to 35.0) Silty CLAY, brown with gray mottling, moist, ~ 90% medium plasticity clay, very stiff.

Note: Portland Cement with 5% bentonite gel placed outside of the surface casing (0.0 to 15.0 foot depth interval).

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Well Materials
(0.0 to 15.0) Surface Casing, 8" sch. 40 PVC
(0.0 to 17.0) Casing, 2" sch. 40 PVC
(17.0 to 27.0) Screen, 2" sch. 40 PVC, 0.01 slot
(27.0 to 27.5) End Cap

Annular Materials
(0.0 to 13.5) Portland Cement with 5% bentonite gel
(13.5 to 15.5) Bentonite chips, 3/8"
(15.5 to 27.5) Sand, 20/40 silica

Lithologic description for 0 to 17 foot depth interval from NG3MW19, borehole caved in from 27.5 to 35 feet.

This boring log should not be used separately from the original report.

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Log of Boring: OB26B

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	05/30/07	Borehole Diameter (in.):	8.25
Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	40
Field Supervisor:	Tim Jennings, PG	Northing:	13554963.98
Drilling Method:	Hollow Stem Auger	Easting:	3154008.4
Sampling Method:	5 ft split spoon	Ground Elev. (ft. MSL):	1.6
		TOC Elev. (ft MSL)	NA

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)
18	0.0	3/3
20	0.0	
22	0.0	5/5
24	0.0	
26	0.0	
28	0.0	5/5
30	0.0	
32	0.0	5/5
34	0.0	
38		5/5

USCS	Lithologic Description
CL	(0.0 to 0.8) Silty, sandy, CLAY, dark gray, wet, ~ 20% silt and very fine-grained sand, ~ 80% medium plasticity clay, soft, abundant roots, abundant organic matter.
CL	(0.8 to 7.5) Sandy CLAY, reddish-brown with gray mottling, moist, ~ 10% fine sand, ~ 90% medium plasticity clay, firm, few oxidized iron nodules.
CL	(7.5 to 10.0) Sandy CLAY, gray with reddish-brown mottling, moist, ~ 10-20% fine-grained sand, ~ 80% medium plasticity clay, firm to soft.
CL	(10.0 to 12.4) Silty CLAY, reddish brown, wet, < 20% low plasticity silt, > 80% high plasticity clay, soft, a few small carbonate concretions
CL	(12.4 to 13.6) Silty CLAY, gray, wet, ~ 50 % silt, ~ 50% medium plasticity clay, very soft.
CL	(13.6 to 15.2) Silty CLAY, reddish-brown with gray mottling, moist, ~ 20% silt and very fine-grained sand, ~ 80% medium plasticity clay, soft.
CL	(15.2 to 17.0) CLAY, gray, moist, low plasticity, friable, a few iron nodules, firm.
CL	(17.0 to 20.2) Silty CLAY, gray with brown mottling, moist, ~ 10-20% silt decreasing with depth, ~ 80-90% medium plasticity clay, very firm, few carbonaceous nodules.
SP	(20.2 to 20.6) Clayey SAND, gray, moist, ~ 40% low plasticity clay, ~ 60% fine-grained sand, firm.
CL	(20.6 to 22.9)) Silty CLAY, gray with brown mottling, moist, ~ 10-20% silt, ~ 80-90% medium plasticity clay, very firm, a few carbonate nodules.
CL	(22.9 to 25.8) Silty CLAY, reddish brown with gray mottling, moist, ~ 10-20% silt, ~ 80-90% medium plasticity clay, < 5% carbonate nodules and seams, locally fractured, very stiff.
CL	(25.8 to 40.0) Silty CLAY, greenish-gray with brown mottling, moist, ~ 10% silt, ~ 90% medium plasticity clay, very firm to stiff, few carbonate nodules, reddish brown below 34 feet, increase in silt from 36.5 to 37 feet, ~ 50% silt, moist.

Note: Portland Cement with 5% bentonite gel placed in the annular space outside of the surface casing (0.0 to 17.0 foot depth interval).

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Well Materials
(0.0 to 17.0) Surface Casing, 8" sch. 40 PVC

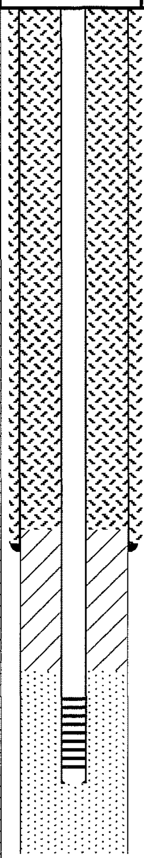
Annular Materials
(17.0 to 40.0) Portland Cement with 5% bentonite gel

Lithologic description for 0 to 17 foot depth interval logged from OMW20 boring

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: OMW27B

Gulfco Marine Maintenance Superfund Site Freeport, TX				
	Completion Date:	05/29/07	Borehole Diameter (in.):	12/8.25
	Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	30
	Field Supervisor:	Tim Jennings, PG	Northing:	13555282.97
PBW Project No. 1352	Drilling Method:	Hollow Stem Auger	Easting:	3154239.25
	Sampling Method:	5 ft split spoon	Ground Elev. (ft. MSL):	2.8
			TOC Elev. (ft MSL)	5.45



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0			CL	(0.0 to 1.4) Sandy, CLAY, dark brown, moist, ~ 10-20% very fine-grained sand, ~ 80-90% medium plasticity clays.
2–10			CL	(1.4 to 10.0) Silty CLAY, reddish-brown, moist, medium plasticity clay, firm to soft, reddish-brown with gray mottling below 4 feet, becomes gray with reddish-brown mottling below 5.7 feet, wet below 8.2 feet.
10–18			CL	(10.0 to 18.8) Sandy silty CLAY, gray, wet, ~ 10-20% very fine-grained sand, ~ 80-90% medium plasticity clay, a few shell fragments, very soft, shell fragments and sand content increasing by 15 feet, light gray, ~ 10-20% shell fragments, ~ 30-40% fine to medium-grained sand, ~ 50-60% medium plasticity clay, sand content decreasing at 17.5 feet, grayish brown, ~ 5% oyster fragments, ~ 10% very fine-grained sand, ~ 85% medium plasticity clay, firm.
20	0.1		CL/SP	(18.8 to 19.0) Silty CLAY, gray, moist, ~ 40-50% silt, ~ 50-60% low plasticity clay, firm.
22	0.0	4/5	CL/SP	(19.0 to 22.4) Sandy, silty, CLAY with poorly graded SAND, brown, wet, ~ 30-40% very fine-grained sand and silt, ~ 60-70% medium plasticity clay, soft.
24			CL	(22.4 to 24.0) Silty CLAY, reddish-brown with gray mottling, moist, medium plasticity, a few carbonate nodules, very firm.
24–26	0.0 0.2		SP	(24.0 to 26.9) SAND, brown, wet, poorly graded, fine-grained, soft.
28–30		4.5/5	CL	(26.9 to 30.0) CLAY, reddish brown with gray mottling to 27.8, gray below 27.8, moist, medium plasticity, very firm.

Note: Portland Cement with 5% bentonite gel placed in the annular space outside of the surface casing (0.0 to 19.0 foot depth interval).

Depth scale (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

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Well Materials

(0.0 to 19.0) Surface Casing, 8" sch. 40 PVC
(0.0 to 24.5) Casing, 2" sch. 40 PVC
(24.5 to 27) Screen, 2" sch. 40 PVC, 0.01 slot
(27.0 to 27.5) End Cap

Annular Materials

(0.0 to 18.5) Portland Cement with 5% bentonite gel
(18.5 to 23.5) Bentonite chips, 3/8"
(23.5 to 30.0) Sand, 20/40 silica

Lithologic description for 0 to 19 foot depth interval logged from OMW21 boring

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

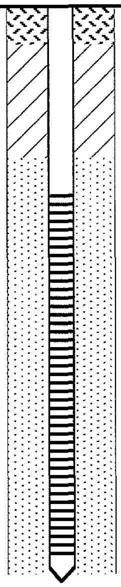
Log of Boring: NC2MW28

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	05/25/07	Borehole Diameter (in.):	8.25
Drilling Company:	Master Monitoring Services, Inc.	Total Depth (ft):	15
Field Supervisor:	Tim Jennings, PG	Northing:	13554651.88
Drilling Method:	Hollow Stem Auger	Easting:	3154233.16
Sampling Method:	5 ft. split spoon	Ground Elev. (ft. MSL):	1.8
		TOC Elev. (ft MSL)	4.76

Well Construction Diagram:



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0 – 0.7	0.2	5/5	CL	(0.0 to 0.7) Sandy CLAY, dark gray, wet, ~ 10% fine-grained sand, ~ 90% medium plasticity clay, soft, abundant roots.
0.7 – 12.6	0.0 (2 ft), 0.0 (4 ft), 0.0 (6 ft), 0.0 (8 ft), 0.0 (10 ft), 0.0 (11 ft)	5/5 (0–5), 4/5 (5–10), 5/5 (10–15)	CL	(0.7 to 12.6) Sandy CLAY with silt, reddish-brown with gray mottling, moist to locally wet, ~ 10-20% very-grained fine sand, ~ 80-90% medium plasticity clay, firm and locally friable, gray mottling increasing below 4.5 feet, brown organic matter from 8 to 8.8 feet, no odor, becoming wet at 10 feet, a few thin sand lenses from 12 to 12.6 feet.
12.6 – 14.1	0.0 (14 ft)		CL/SP	(12.6 to 14.1) Sandy silty CLAY, gray, wet, ~ 20-30% fine-grained sand, ~ 20-30% silt, ~ 50% medium plasticity clay, very soft, few oyster shells, a few thin (< 0.1") sand interbeds.
14.1 – 15.0			CL	(14.1 to 15.0) Silty CLAY, reddish-brown with gray mottling, moist, ~ 10-20% silt, ~ 80-90% medium plasticity clay, firm.

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

Well Materials
(0.0 to 5.0) Casing, 2" sch. 40 PVC
(5.0 to 14.5) Screen, 2" sch. 40 PVC, 0.01 slot
(14.5 to 15.0) End Cap

Annular Materials
(0.0 to 1.0) Portland Cement with 5% bentonite gel
(1.0 to 4.0) Bentonite chips, 3/8"
(4.0 to 15.0) Sand, 20/40 silica

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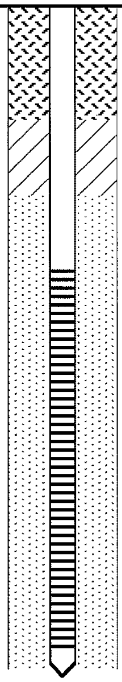
PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: ND3MW29		
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date: 05/31/07	Borehole Diameter (in.):	8.25
	Drilling Company: Master Monitoring Services, Inc.	Total Depth (ft):	17.5
	Field Supervisor: Tim Jennings, PG	Northing:	13554733.7
PBW Project No. 1352	Drilling Method: Hollow Stem Auger	Easting:	3154525.86
	Sampling Method: 5 ft. split spoon	Ground Elev. (ft. MSL):	2.9
		TOC Elev. (ft MSL)	5.33



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0–1.8	4.2	4.5/5	CL	(0.0 to 1.8) Sandy CLAY with gravel, brown with gray mottling, locally moist, ~ 20% fine-grained sand, ~ 80% medium plasticity clay, < 5% gravel and shell fragments, soft.
1.8–7.1	117, 249, 276	4.5/5	CL	(1.8 to 7.1) Silty CLAY, gray to dark gray, wet from 1.8 to 2.6 feet, moist below 2.6 feet, soft to firm, decaying marsh type vegetation from 1.8 to 2.6 feet.
7.1–12.5	162, 585	3/5	CL/SM ML	(7.1 to 12.5) Sandy silty CLAY, brown, wet, ~ 10-20% fine-grained sand, ~ 30-80% silt, ~ 30-60% medium plasticity clay, soft, wood fragments and black staining from 8.3 to 8.6 feet, moderate creosote like odor, local black staining from 10.5 to 12 feet.
12.5–16.6	884, 527	2.5/2.5	SP/SM	(12.5 to 16.6) Poorly graded SAND and silty SAND, brown, wet, ~ 10-30% silt, wet locally from 12.5 to 13.5 feet and wet below 15.4 feet, ~ 70 -100% very fine to fine-grained sand, locally abundant NAPL visible within sand from 12.5 to 13.5 feet and slight to moderate NAPL (sheen) visible within sand from 15 to 16.4 feet, moderate organic odor, soil sample (SB-MW29-01) collected from 12.5 to 13.5 feet.
16.6–17.5			CL	(16.6 to 17.5) Silty CLAY, reddish-brown, wet, ~ 10-20% silt, ~ 80-90% medium plasticity clay, very soft, no NAPL staining or sheen observed within clay.

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

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Well Materials

(0.0 to 7.0) Casing, 2" sch. 40 PVC
(7.0 to 17.0) Screen, 2" sch. 40 PVC, 0.01 slot
(17.0 to 17.5) End Cap

Annular Materials

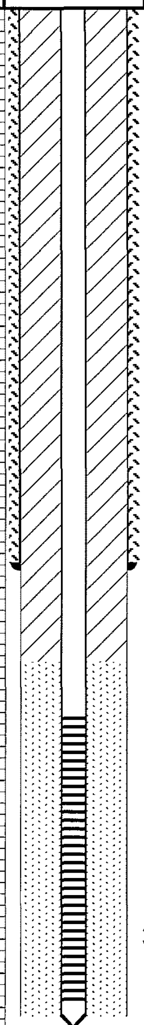
(0.0 to 3.0) Portland Cement with 5% bentonite gel
(3.0 to 5.0) Bentonite chips, 3/8"
(5.0 to 17.5) Sand, 20/40 silica

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: NE3MW30B			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	11/26/07	Borehole Diameter (in.):	12.5/8.25
	Drilling Company:	Universal Drilling Services	Total Depth (ft):	35.5
	Field Supervisor:	Len Mason, PG	Northing:	13554690.78
PBW Project No. 1352	Drilling Method:	Hollow Stem Auger	Easting:	3154741.85
	Sampling Method:	5 ft core barrel	Ground Elev. (ft. MSL):	3.5
			TOC Elev. (ft MSL)	6.70

Depth (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

Well Construction Diagram



PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
	4.7/5	CL	(0.0-0.9) Sandy, silty, CLAY, brown with some orange mottling, moist, ~ 10-15% very fine sand, ~ 30% silt, soft, medium to low plasticity.
		CL	(0.9-2.8) CLAY, brown, moist, medium plasticity, trace wood fragment at 1.8 feet.
	4/5	CL	(2.8-8.0) Sandy CLAY, gray, moist to wet at 4.5 feet, some (~ 10%) sandy lenses, soft, medium-high plasticity, gray with some brown mottling below 5 feet.
	5/5	CL	(8.0-12.5) Sandy CLAY, brown with gray mottling to 10 feet, brown below 10 feet, moist, ~ 20-30% fine sand, very soft, medium plasticity, becomes wet below 11.2 feet.
	2.5/3	SM	(12.5-17.0) Silty SAND, brown, wet, sand is very fine, ~ 20% silt, loose.
		SM-SC	(17.0-18.0) Clayey, silty, SAND, brown with some gray, wet, ~ 10-15% gray clay, ~ 30% silt, sand is very fine, loose.
	2/2	CL	(18.0-20.0) CLAY with some silty sand zones, brown, moist, soft, medium-high plasticity, becomes gray and firm at 19 feet.
246	2/5	SM	(20.0-25.0) Silty SAND, brown, wet, sand is very fine, loose, chemical odor, sheen observed, flowing sand.
205	2/2.5	CH	(25.0-25.5) Slightly sandy CLAY, gray, moist, ~ 5-10% very fine sand, soft, medium-high plasticity, chemical odor.
133		SC	(25.5-26.4) Slightly clayey SAND, brown and gray, wet, ~ 10% fine clay layers throughout, sand very fine, slight odor.
135		CH	(26.4-26.8) Sandy CLAY, brownish-gray, moist, high plasticity, soft to firm.
86.4		SM/SP	(26.8-27.5) Silty SAND with some shell material, gray, wet, sand is very fine, ~ 20% silt, chemical odor.
	2/2.5	CL	(27.5-28.5) Sandy CLAY, gray, moist, ~ 20-30% fine sand, soft, high plasticity, chemical odor, wet gray sand layer with shell material from 28-28.2 feet.
535	1/2.5	SW	(29.5-34.1) SAND, brown to gray, wet, shell material throughout, fine to medium sand, subrounded to subangular, strong chemical odor, sheen throughout, locally abundant NAPL visible within sand from 33.9 to 34.1, soil sample (SBMW30-01) collected from 33.6-34.1 feet..
3109	2.5/2.5		
304		CL	(34.1-35.5) CLAY, gray, moist, high plasticity, firm, fat clay, slight odor, no NAPL staining or sheen observed within clay.

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Well Materials	Annular Materials
(0.0 to 19.5) Surface Casing, 12" sch. 40 PVC	(0.0 to 18.5) Portland Cement with 5% bentonite gel outside of surface casing
(0.0 to 25.0) Casing, 2" sch. 40 PVC	(0.0 to 23.0) Bentonite chips, 3/8" inside surface casing
(25.0 to 35.0) Screen, 2" sch. 40 PVC, 0.01 slot	(23.0 to 35.5) Sand, 16/30 silica
(35.0 to 35.5) End Cap	

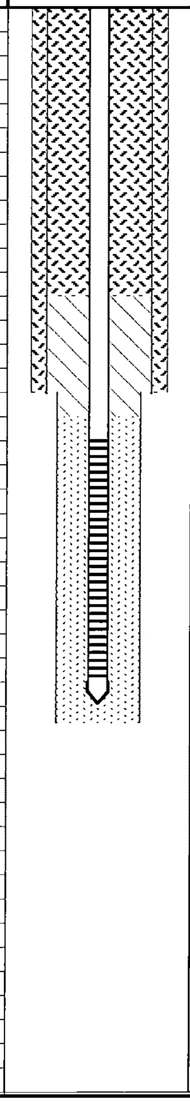
This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: NE4MW31B

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	06/13/08	Borehole Diameter (in.):	8.0/13.0
Drilling Company:	Universal Drilling	Total Depth (ft):	45
Field Supervisor:	Tim Jennings, P.G.	Northing:	3154903.18
Drilling Method:	Hollow Stem Auger	Easting:	13554709.81
Sampling Method:	5 ft. split spoon	Ground Elev. (ft. MSL):	3.0
		TOC Elev. (ft MSL)	6.01



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0			RD BASE	(0.0-0.8) Caliche road base.
	0.2, 0.3	5/5	CL/CH	(0.8-6.2) Sandy CLAY, gray with brown mottling, moist, ~5 to 10% fine-grained sand, ~ 90 to 95% medium to high plasticity clays.
5	0.4, 0.2	5/5	CH	(6.2-8.5) Silty sandy CLAY, brown with gray mottling, moist to locally wet, ~5 to 10% fine-grained sand, ~15 to 20% silt, ~70 to 80% high plasticity clay, soft.
			ML	(8.5-9.4) Clayey SILT, grayish-brown, wet, ~30 to 40% high plasticity clay, ~60 to 70% silt, soft.
10			SM	(9.4-11.3) Silty SAND, grayish-brown to brown, wet, ~10 to 30% silt, ~70 to 90% fine-grained sand, soft.
	0.2, 0.2	5/5	ML	(11.3-13.4) Sandy clayey SILT, brown, wet, ~10 to 20% high plasticity clay, ~20 to 30% fine-grained sand, ~50 to 70% silt, very soft.
	0.2		CH	(13.4-16.0) Sandy CLAY, grayish-brown, wet, ~10 to 20% very fine-grained sand, ~80 to 90% high plasticity clay, very soft.
15		1/5	NR	(16.0-20.0) NO RECOVERY.
20	0.2	2.5/5	SP	(20.0-30.0) SAND, poorly graded, brown, wet, very fine-grained to medium-grained sand with ~5% shell fragments at 20.0 to 21.5, very fine-grained to fine-grained sand with trace shell fragments at 21.5 to 30.0, firm, trace gray clay.
25		2.5/5		
30		0/5	NR	(30.0-40.0) NO RECOVERY in flowing sands.
35		0/5		
40		0.25/5	CL	(40.0-45.0) Sandy CLAY in shoe of core barrell, only recovered 0.2', drilled like clay.
45				

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Well Materials
(0.0-16.0) Surface Casing, 10" sch. 40 PVC
(0.0-18.0) Casing, 2" sch. 40 PVC
(18.0-28.0) Screen, 2" sch. 40 PVC, 0.01" slot
(28.0-28.3) End Cap

Annular Materials
(0.0-12.0) Cement/Bentonite slurry, inside surf. casing
(0.0-16.0) Cement/Bentonite slurry, outside surf. casing
(12.0-17.0) 3/8" bentonite chips, inside surf. casing
(17.0-29.7) 16/30 silica sand

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: NE4MW32C			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	06/13/08	Borehole Diameter (in.):	8.0/13.0/17.5
	Drilling Company:	Universal Drilling	Total Depth (ft):	80
	Field Supervisor:	Tim Jennings, P.G.	Northing:	3154802.32
	Drilling Method:	Hollow Stem Auger	Easting:	13554653.07
PBW Project No. 1352	Sampling Method:	5 ft. split spoon	Ground Elev. (ft. MSL):	3.2
			TOC Elev. (ft MSL)	6.31

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0			RD BASE	(0.0-0.5) Caliche road base, plugged sampler, no recovery.
		0.25/5	CL	(0.5-5.0) Sandy CLAY.
5	0.5	0.5/5	ML	(5.0-10.0) Sandy SILT, brown, wet, ~20 to 30% fine-grained sand, ~70 to 80% low plasticity silt.
10	0.1 0.1	5/5	SM	(10.0-14.4) Silty clayey SAND, brown, wet, ~10 to 20% medium plasticity clay in thin (<0.5") interbeds, 20 to 30% low plasticity silt, ~50 to 80% fine-grained sand, soft.
15	0.1 0.2	5/5	SP	(14.4-19.2) SAND, poorly graded, brown, wet, very fine-grained to fine-grained sand, soft; black, natural organic material locally.
			CL	(19.2-20.5) CLAY, grayish-brown, wet, medium plasticity clay, locally bedded, soft.
20	0.6	5/5	CL	(20.5-26.2) Sandy CLAY, grayish-brown, wet, ~20 to 30% fine-grained sand, ~70 to 80% medium plasticity clay, very soft, barrel filled with cuttings and slough from inside casing--resulted in poor recovery.
25	44.1	2.5/5	SP	(26.2-29.0) SAND, grades to poorly graded sand, brown, wet, very fine-grained to fine-grained sand, very soft.
30	14.2	3/5	SP	(29.0-35.0) Poorly graded SAND and clayey SAND, wet, ~10% high plasticity clay in sand locally, ~90% fine-grained to medium-grained sand, shell fragments throughout.
35	0	2/5	SP	(35.0-40.2) SAND, poorly graded, brown, wet, very fine-grained to fine-grained sand, compact, gray below 39.0.
40	1		CH	(40.2-41.7) CLAY, gray, wet, high plasticity clay, soft.

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Well Materials
(0.0-20.0) Surface Casing, 14" sch. 40 PVC
(0.0-48.8) Surface Casing, 10" sch. 40 PVC
(0.0-64.0) Casing, 2" sch. 40 PVC
(64.0-74.0) Screen, 2" sch. 40 PVC, 0.01" slot
(74.0-74.3) End Cap

Annular Materials
(0.0-10.0) Bentonite chips, inside 10" casing
(0.0-20.0) Cement/Bentonite slurry, outside 14" casing
(0.0-48.8) Cement/Bentonite slurry, outside 10" casing
(10.0-58.3) Cement/Bentonite slurry, inside 10" casing
(58.3-62.0) 3/8" bentonite chips
(62.0-76.0) 16/30 silica sand
(76.0-80.0) Coated bentonite pellets

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

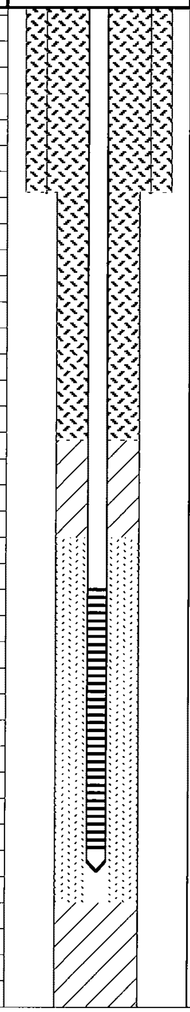
Log of Boring: NE4MW32C

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	06/13/08	Borehole Diameter (in.):	8.0/13.0/17.5
Drilling Company:	Universal Drilling	Total Depth (ft):	80
Field Supervisor:	Tim Jennings, P.G.	Northing:	3154802.32
Drilling Method:	Hollow Stem Auger	Easting:	13554653.07
Sampling Method:	5 ft. split spoon	Ground Elev. (ft. MSL):	3.2
		TOC Elev. (ft MSL)	6.31

Well Construction Diagram



Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
41.7–45.8		3/5	SP	(41.7-45.8) Poorly graded SAND and clayey SAND, gray, wet, ~20% high plasticty clay, ~80% fine-grained sand.
45.8–47.1	9.2	5/5	CH	(45.8-47.1) CLAY, gray, wet, high plasticity clay.
47.1–47.4			SP	(47.1-47.4) SAND, poorly graded, gray, wet, fine-grained to medium-grained sand interbedded in clay.
47.4–47.7	0.9		CH	(47.4-47.7) CLAY, gray, wet.
47.7–55.0		3/3, 2/2	CL	(47.7-55.0) Sandy CLAY, reddish-brown with gray mottling, ~5 to 10% very fine-grained sand, ~90 to 95% medium plasticity clay, a few small shell fragments near top, very stiff and dense.
55.0–60.0	0.1	2/2, 3/3	CH	(55.0-60.0) Silty CLAY, gray with local red mottling, moist, ~5 to 10% silt as very thin interbeds and lenses, a few silt lenses and thin (<0.1') interbeds at 57.0 to 58.5.
60.0–60.5			CH	(60.0-60.5) CLAY, gray, ~20 to 30% shell fragments.
60.5–72.7	0, 0.2, 0.5	5/5, 5/5	CH	(60.5-72.7) CLAY, very dark gray, moist, high plasticity, clay with abundant natural organic material at 62.5 to 68.0, a few shell fragments.
72.7–73.0	0.3	5/5	SHELL	(72.7-73.0) SHELL layer, appears to contain some water.
73–73.8			CH	(73-73.8) CLAY, similar to the material at 60.5 to 72.7.
73.8–80	0.3	5/5	CH	(73.8-80) CLAY, bluish-gray, moist, high plasticity clay with few shell fragments, very firm to stiff, thin silt bed at 77.7.

Well Materials	Annular Materials
(0.0-20.0) Surface Casing, 14" sch. 40 PVC	(0.0-10.0) Bentonite chips, inside 10" casing
(0.0-48.8) Surface Casing, 10" sch. 40 PVC	(0.0-20.0) Cement/Bentonite slurry, outside 14" casing
(0.0-64.0) Casing, 2" sch. 40 PVC	(0.0-48.8) Cement/Bentonite slurry, outside 10" casing
(64.0-74.0) Screen, 2" sch. 40 PVC, 0.01" slot	(10.0-58.3) Cement/Bentonite slurry, inside 10" casing
(74.0-74.3) End Cap	(58.3-62.0) 3/8" bentonite chips
	(62.0-76.0) 16/30 silica sand
	(76.0-80.0) Coated bentonite pellets

This boring log should not be used separately from the original report.

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PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: NB4PZ01			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	07/21/06	Borehole Diameter (in.):	2
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	22
	Field Supervisor:	Len Mason, P.G.	Northing:	13554276.47
	Drilling Method:	Direct Push	Easting:	3154459.85
PBW Project No. 1352	Sampling Method:	4 ft split spoon	Ground Elev. (ft. MSL):	2.3
			TOC Elev. (ft MSL):	---

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0			SC/SM	(0.0 to 0.7) Clayey silty SAND, brown, very fine-grained, subrounded, quartz, very low plasticity to uncohesive, dry.
2	0.5	3.1/4		
4	0.8			
6	0.8	3.6/4	CL	(0.7 to 13.1) CLAY, brown and gray, slightly mottled, soft, medium plasticity, slightly moist, becoming soft and moist below 5.4; becoming very soft at 6.6; becoming very moist to saturated at 8.0; becoming mostly greenish-gray with some brown, moist to very moist, saturated in areas at 9.0.
8	0.9			
10	0.9	3.8/4		
12	0.9			
14		3.7/4		
16	1.3		ML	(13.1 to 18.9) Slightly sandy clayey SILT, brown, and greenish gray, very soft, uncohesive, saturated.
18	1.6	4/4		
20	1.9	2/2	CL	(18.9 to 22.0) CLAY, gray to olive gray, firm, medium plasticity, slightly moist to dry, trace gravel.
22	1.7			
24				
26				
28				
30				

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Comments:

A temporary piezometer (screened interval 9 - 19 ft.) was installed adjacent to this location.

The borehole was plugged with bentonite pellets.

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: NC3PZ02			
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date:	07/21/06	Borehole Diameter (in.):	2
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	28
	Field Supervisor:	Len Mason, P.G.	Northing:	13554519.81
	Drilling Method:	Direct Push	Easting:	3154398.52
PBW Project No. 1352	Sampling Method:	4 ft split spoon	Ground Elev. (ft. MSL):	2.9
			TOC Elev. (ft MSL):	---

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0				
2	0.6	3.6/4		
4	0.9			
6	0.9	3.9/4		
8	1.2		CL	(0.0 to 14.6) Silty CLAY, reddish-brown to brown, soft, low plasticity, slightly moist; becoming gray and reddish-brown to brown, slightly mottled at 3.0; becoming greenish-gray and brown, slightly mottled, very soft at 8.0.
10	1.5	3.6/4		
12				
14		4/4		
			ML	(14.6 to 15.9) Clayey SILT, brown and grayish-brown, saturated, very soft, uncohesive.
16	0.6			(15.9 to 17.0) CLAY, gray, medium plasticity, soft to firm, moist.
18	1	3.8/4		(17.0 to 19.3) Silty CLAY, brown and gray, very soft, uncohesive, very moist.
20	1.9			(19.3 to 20.0) CLAY, gray, some greenish-gray, soft to firm, medium plasticity, slightly moist.
22	2	3.7/4	CL	(20.0 to 22.5) Silty CLAY, brown and gray, very soft, uncohesive, very moist.
24	1.4			
26	1.1	3.8/4		(22.5 to 28.0) CLAY, trace gravel, gray and olive-brown, mottled, reddish-brown at 26.7 to 27.6, firm, slightly moist to dry, medium plasticity.
28	1.7			
30				

PBW

Pastor, Behling & Wheeler, LLC
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Tel (512) 671-3434 Fax (512) 671-3446

Comments:

A temporary piezometer (screened interval 12.5 - 22.5 ft.) was installed adjacent to this location.

The borehole was plugged with bentonite pellets.

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: ND1PZ03		
Gulfco Marine Maintenance Superfund Site Freeport, TX	Completion Date: 07/21/06	Borehole Diameter (in.):	2
	Drilling Company: Best Drilling Services, Inc.	Total Depth (ft):	18
	Field Supervisor: Len Mason, P.G.	Northing:	13554945.56
	Drilling Method: Direct Push	Easting:	3154263.8
PBW Project No. 1352	Sampling Method: 4 ft split spoon	Ground Elev. (ft. MSL):	2.2
		TOC Elev. (ft MSL):	---

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0			CL	(0.0 to 1.2) Slightly sandy, silty CLAY, brown; very fine-grained, subrounded, quartz sand; firm, medium plasticity, slightly moist.
2	6.2	2.9/4		(1.2 to 15.7) CLAY, brown and gray, slightly mottled, soft to firm, medium plasticity, slightly moist, very moist at 4.0, some black staining at 10.2, saturated and very soft at 12.0.
4	10.5			
6	8.8	3.7/4		
8	25.2			
10	12.5	3.9/4		
12	44.7			
14	24.9	3.9/4		
16	17.9	1/2		(15.7 to 18.0) CLAY, gray, firm, medium plasticity, dry to slightly moist.
18	29.3			
20				
22				
24				
26				
28				
30				

PBW

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Comments:

A temporary piezometer (screened interval 5.5 - 15.5 ft.) was installed adjacent to this location.

The borehole was plugged with bentonite pellets.

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

Log of Boring: ND3PZ04

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/21/06	Borehole Diameter (in.):	2
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	20
Field Supervisor:	Len Mason, P.G.	Northing:	13554698.81
Drilling Method:	Direct Push	Easting:	3154524.94
Sampling Method:	4 ft split spoon	Ground Elev. (ft. MSL):	2.4
		TOC Elev. (ft MSL):	---

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0			CL	(0.0 to 1.1) Slightly sandy CLAY, gray, some olive-brown; very fine-grained, subrounded sand; soft, low plasticity, slightly moist.
2	60.1	3/4	CL	(1.1 to 4.5) CLAY, gray, some olive-brown, soft to slightly firm, medium plasticity, slightly moist.
4				
6	167	2.9/4	CL/ML	(4.5 to 6.5) Silty CLAY to clayey SILT, brown and gray, mottled, very soft, low plasticity, very moist to saturated, slight odor.
	181		ML	
8	170		ML	
10	304	3.5/4	ML	
12	121		ML	(6.5 to 17.0) Sandy clayey SILT, brown; very fine-grained, poorly sorted, subrounded, quartz sand; uncohesive, saturated, odor.
14	166	3.9/4	ML	
16	13		ML	
18	28.1	3.8/4	CL	(17.0 to 20.0) CLAY, brown, some gray, very soft, medium plasticity, moist, odor, becoming greenish-gray, firm to medium plasticity, slightly moist to dry, trace iron nodules at 19.0.
20	8.1			
22				
24				
26				
28				
30				

PBW
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Comments:

A temporary piezometer (screened interval 7 - 17 ft.) was installed adjacent to this location.

The borehole was plugged with bentonite pellets.

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: NF1PZ05

Gulfco Marine Maintenance Superfund Site Freeport, TX				
	Completion Date:	08/01/06	Borehole Diameter (in.):	2
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	18
	Field Supervisor:	Tim Jennings, P.G.	Northing:	13555211
	Drilling Method:	Direct Push	Easting:	3154490.84
PBW Project No. 1352	Sampling Method:	4 ft split spoon	Ground Elev. (ft. MSL):	2.2
			TOC Elev. (ft MSL):	---

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0	3.1			
2		1/4	CL	(0.0 to 6.2) Sandy CLAY, dark grayish-brown, moist, ~ 20% fine-grained sand, ~ 80% medium plasticity clay, firm.
4	4.9			
6	5.8	3/4	SC/SM	(6.2 to 8.0) Silty clayey SAND, brown, wet, ~ 50% medium plasticity fines, ~ 50% very fine to fine-grained sand, soft.
8	4.8		CH	(8.0 to 9.7) Silty CLAY, gray to brown, wet, high plasticity, soft.
10	3.6	4/4	SM/SC	(9.7 to 12.0) Silty clayey SAND, brown, wet, ~ 20% to 30% high plasticity fines, ~ 70% to 80% very fine to fine-grained sand, soft.
12	1.3		CH	(12.0 to 13.4) Silty sandy CLAY, brown, wet, ~ 30% to 40% very fine-grained sand and silt, ~ 60% to 70% high plasticity clay, very soft.
14	1.2	4/4	SM/CH	(13.4 to 16.7) Silty SAND and CLAY, brown, wet, ~ 20% to 30% high plasticity fines (thin clay interbeds), ~ 70% to 80% very fine to fine-grained sand, soft.
16	1.3	2/2	CH/SP	(16.7 to 18.0) Interbedded CLAY and SAND, ~30% poorly graded sand as thin (< 0.1 inch) beds and ~ 70% high plasticity clay, top of first confining clay.
18				
20				
22				
24				
26				
28				
30				

PBW

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Comments:

A temporary piezometer (screened interval 8 - 18 ft.) was installed adjacent to this location.

The borehole was plugged with bentonite pellets.

This boring log should not be used separately from the original report.

076986

PASTOR, BEHLING & WHEELER, LLC
Consulting Engineers and Scientists

Log of Boring: NF3PZ06

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/31/06	Borehole Diameter (in.):	2
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	16
Field Supervisor:	Tim Jennings, P.G.	Northing:	13554991.77
Drilling Method:	Direct Push	Easting:	3154813.75
Sampling Method:	4 ft split spoon	Ground Elev. (ft. MSL):	2.5
		TOC Elev. (ft MSL):	---

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0–4	2.6, 1.8	4/4	CL	(0.0 to 4.8) Silty CLAY, dark brown to gray, moist, medium plasticity fines, abundant roots, firm.
4–8	2.3	2/4	CL	(4.8 to 13.1) Silty sandy CLAY, brown, wet, ~ 30% to 40%, fine sand, ~ 60% to 70% medium plasticity fines, very soft.
8–12	1.3, 2.7	4/4	CL	
12–16	4.5, 4.7	4/4	CH	(13.1 to 14.7) Silty CLAY, brown, moist, high plasticity fines, soft, first confining clay.
			SW	(14.7 to 16.0) Well-graded SAND, brown, wet, very fine to medium-grained sand with shell fragments.

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

PBW
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Comments:

A temporary piezometer (screened interval 3 - 13 ft.) was installed adjacent to this location.

The borehole was plugged with bentonite pellets.

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: SA4PZ07

Gulfco Marine Maintenance
Superfund Site
Freeport, TX

PBW Project No. 1352

Completion Date:	07/20/06	Borehole Diameter (in.):	2
Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	24
Field Supervisor:	Len Mason, P.G.	Northing:	13553911.84
Drilling Method:	Direct Push	Easting:	3154746.34
Sampling Method:	4 ft split spoon	Ground Elev. (ft. MSL):	5.4
		TOC Elev. (ft MSL):	---

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0			SC	(0.0 to 1.5) Clayey SAND, brown with strong brown, plant material, loose, dry, trace gravel.
2	0.5	3/4	CL	(1.5 to 2.0) Silty CLAY, brown, reddish-brown, some black, slightly mottled, soft, medium plasticity, organic material at base.
			SM/SC	(2.0 to 4.1) Clayey silty SAND; brown, grayish-brown, and reddish-brown, trace mottling, very fine-grained, subrounded, poorly sorted sand, unconsolidated, some root material, slightly moist, partially decayed plant material at 4.0.
4	0.6			
6	0.6	3.5/4	CL	(4.1 to 8.0) CLAY, gray, soft to firm, medium plasticity; becomes mottled gray, greenish gray, and reddish brown at 5.4; becomes very moist at 5.4; saturated, silty sand lens (< 0.1 feet) at 5.4.
8	0.6		SC/SM	(8.0 to 9.6) Clayey, silty SAND, grayish-brown, some reddish-brown, very fine-grained, subrounded, poorly sorted sand, unconsolidated, saturated, sharp basal contact.
10	0.8	3.9/4		
12	0.7			
14	0.6	3.9/4		
16	0.6		CL	(9.6 to 24.0) Silty CLAY, reddish-brown with some light greenish gray, slightly mottled, soft, medium plasticity, moist; becoming more greenish-gray with some reddish brown and trace black at 10.5; becoming reddish-brown at 14.9; becoming greenish-gray with local areas of reddish-brown, very soft, very moist at 16.0; becoming dry and firm at 22.6.
18	0.5	4/4		
20	0.7			
22	0.7	3.9/4		
24	1.1			
26				
28				
30				

PBW

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Comments:

A temporary piezometer (screened interval 12 - 22 ft.) was installed adjacent to this location.

The borehole was plugged with bentonite pellets.

This boring log should not be used separately from the original report.

PASTOR, BEHLING & WHEELER, LLC Consulting Engineers and Scientists	Log of Boring: SD3PZ08

Gulfco Marine Maintenance Superfund Site Freeport, TX				
	Completion Date:	07/20/06	Borehole Diameter (in.):	2
	Drilling Company:	Best Drilling Services, Inc.	Total Depth (ft):	28
	Field Supervisor:	Len Mason, P.G.	Northing:	13554214.87
	Drilling Method:	Direct Push	Easting:	3154926.63
PBW Project No. 1352	Sampling Method:	4 ft split spoon	Ground Elev. (ft. MSL):	5.6
			TOC Elev. (ft MSL):	---

Depth (ft)	PID (ppm-v)	Recovery (ft/ft)	USCS	Lithologic Description
0			Fill	(0.0 to 0.5) GRAVEL with sand.
			CL	(0.5 to 2.4) CLAY, brown, greenish-gray and black, slightly mottled, soft, medium plasticity, slightly moist.
2	1.1	3.5/4		
			SM	(2.4 to 4.6) Silty SAND, light brown, sand is fine-grained, subrounded, poorly sorted, mostly quartz, unconsolidated, slightly moist, becoming silty clay near base.
4	1.2			
6	1.9	4/4	CL	(4.6 to 8.7) CLAY, dark gray to dark greenish-gray, some reddish-brown, slightly mottled, soft, medium plasticity, slightly moist, trace root material.
8	2			
				(8.7 to 9.8) Sandy silty CLAY, grayish-brown, soft, low plasticity, moist, some sand stringers, very thin, sand is very fine-grained and subrounded.
10	1.6	4/4		(9.8 to 11.5) CLAY, gray and strong brown, mottled, soft, medium plasticity, moist.
12	1.7		ML	(11.5 to 13.7) Clayey, sandy SILT, brown and brownish-gray, soft, unconsolidated, very moist to saturated, becoming saturated at 12.1.
14	1.6	3.5/4		
16	1.5			
18	1.5	3.8/4		
20	1.2		ML/SC	(13.7 to 25.5) Slightly clayey, sandy SILT, brown, sand is very fine-grained, mostly quartz, unconsolidated, saturated, sand stringers throughout, slightly less saturated at 21.9.
22	1.1	3.7/4		
24	1.6			
26	1.6	4/4	CL	(25.5 to 28.0) CLAY, greenish-gray and brown, mottled, firm, medium to high plasticity, slightly moist.
28	1.1			
30				

PBW

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Comments:

A temporary piezometer (screened interval 12 - 22 ft.) was installed adjacent to this location.

The borehole was plugged with bentonite pellets.

This boring log should not be used separately from the original report.

Pastor, Behling & Wheeler Consulting Engineers and Scientists	Log of Boring: SE1DB01

Gulfco Marine Maintanence Superfund Site Freeport, TX	Completion Date:	6/24/08	Drilling Method:	Mud Rotary
	Drilling Company:	Vortex Drilling	Borehole Diameter (in.):	4
	Field Supervisor:	Tim Jennings, P.G.	Total Depth (ft):	200
PBW Project No. 1352	Sampling Method:	Shelby Tube	Northing:	Not Measured
			Easting:	Not Measured
			Ground Elev. (ft AMSL):	Not Measured

Depth (ft)	Sample Interval	USCS	Lithologic Description
0–20		CL	(0.0-20.0) Silty CLAY, reddish brown-gray, ~10-20% silt, ~80-90% medium plasticity clay, <5% fine gravel.
20–35		CL/SM	(20.0-35.0) Sandy Silty CLAY, grayish-brown, ~20-30% fine sand and silt, ~70-80% medium plasticity clay, likely mixed with Zone A sand & clays above & below.
35–45		CL	(35.0-45.0) Sandy CLAY, gray, ~10-20% fine sand, ~80-90% high plasticity clay, trace black natural organic matter, driller reports much softer drilling @ 45'.
45–60		CL	(45.0-60.0) Silty CLAY, reddish-brown, ~10-20% silt, ~80-90% medium plasticity clay, drilling firm.
60–65		CL	(60.0-65.0) Silty CLAY as above, driller reports drilling is soft, mixed in 20 lbs of bentonite gel with natural drilling fluid at 60'.
65–70		CL	(65.0-70.0) Silty CLAY as above with <5% silty sand fragments and a few shell fragments.
70–80		CL	(70.0-80.0) Silty CLAY as above, poor cuttings returned likely due to clay "boot" in annular space.
80–90	80–82	CH	(80.0-90.0) CLAY , bluish gray, high plasticity clay, firm to stiff, shelby tube sample collected at 80-82'.
90–110		CL	(90.0-100.0) CLAY as above, with <5% shell fragments.
110–120		CL	(110.0-120.0) CLAY as above, slight increase in shell fragments.
120–130		CL	(120.0-130.0) CLAY as above, slight increase in shell fragments, driller reports thin soft zone (possibly sand or shell) at 126'.
130–140		CL	(130.0-140.0) CLAY as above with slight increase in shell fragments.
140–150		CL	(140.0-150.0) CLAY as above, with ~50% shell fragments - driller reports still drilling like clay.
150–160		CL	(150.0-160.0) CLAY, ~80-90% reddish-brown clay with ~10-20% shell fragments.
160–170		CL	(160.0-170.0) CLAY as above.
170–180		CL	(170.0-180.0) CLAY, gray with ~10-20% shell fragments.
180–190		CL	(180.0-190.0) CLAY, gray, as above.
190–200		CL	(190.0-200.0) CLAY as above, with ~30% shell fragments.

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Notes:

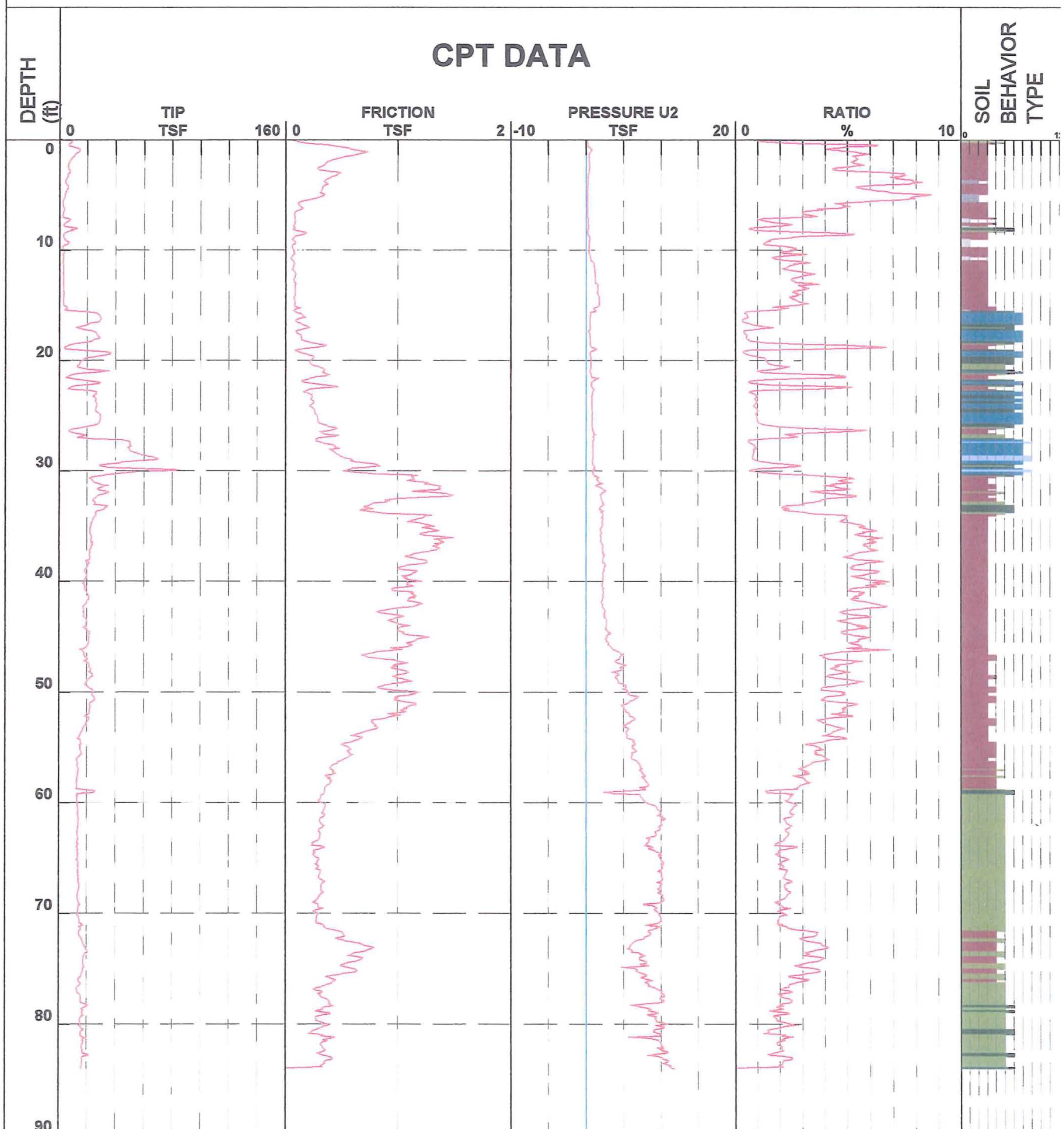
Lithologic descriptions based on cuttings return samples. Borehole geophysically logged upon completion. Borehole backfilled with cement/bentonite grout (placed by tremie) upon completion of geophysical logging.

APPENDIX D

CPT PROFILES

CPT Data

Job Number	04.1908-0042	CPT Number	NG3-CPT1	Location	Gulfco Site-Freeport-TX
Operator	ALBERT FONSECA	Date and T	03-Jun-2008 08:55:23	Cone Number	A15F2.5CKEHW1636
Client		Elevation		Water Table	0.00 ft



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented

076992

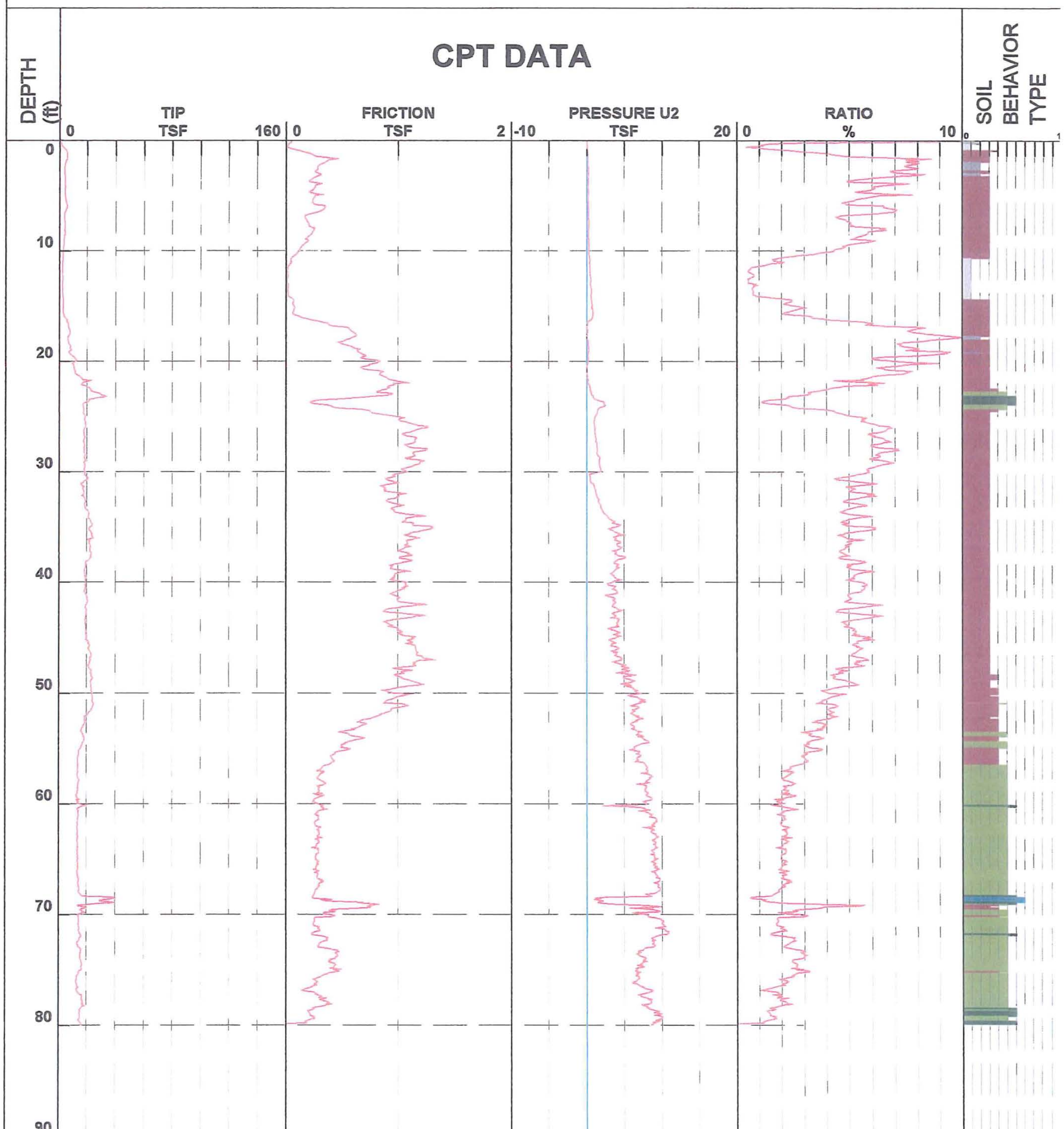
CPT Data

FUGRO

Job Number 04.1908-0042 | CPT Number NC2-CPT3 | Location Gulfco Site-Freeport-TX

Operator ALBERT FONSECA | Date and T 02-Jun-2008 14:04:29 | Cone Number A15F2.5CKEHW1636

Client | Elevation | Water Table 0.00 ft



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented

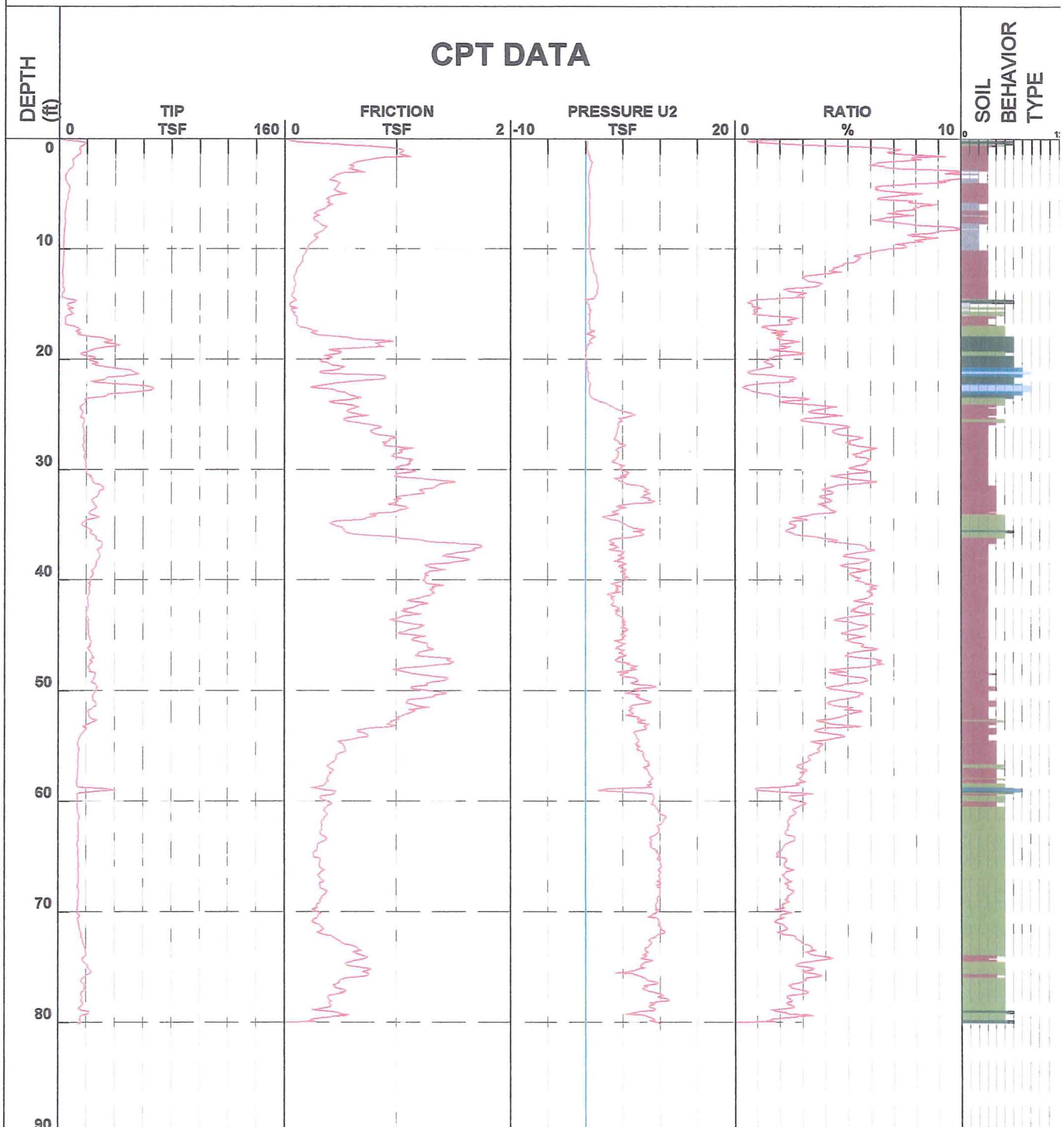
CPT Data

FUGRO

Job Number 04.1908-0042 | CPT Number OCPT-4 | Location Gulfco Site-Freeport-TX

Operator ALBERT FONSECA | Date and T 03-Jun-2008 16:42:24 | Cone Number A15F2.5CKEHW1636

Client | Elevation | Water Table 0.00 ft



1 - sensitive fine grained | 4 - silty clay to clay | 7 - silty sand to sandy silt | 10 - gravelly sand to sand

2 - organic material | 5 - clayey silt to silty clay | 8 - sand to silty sand | 11 - very stiff fine grained (*)

3 - clay | 6 - sandy silt to clayey silt | 9 - sand | 12 - sand to clayey sand (*)

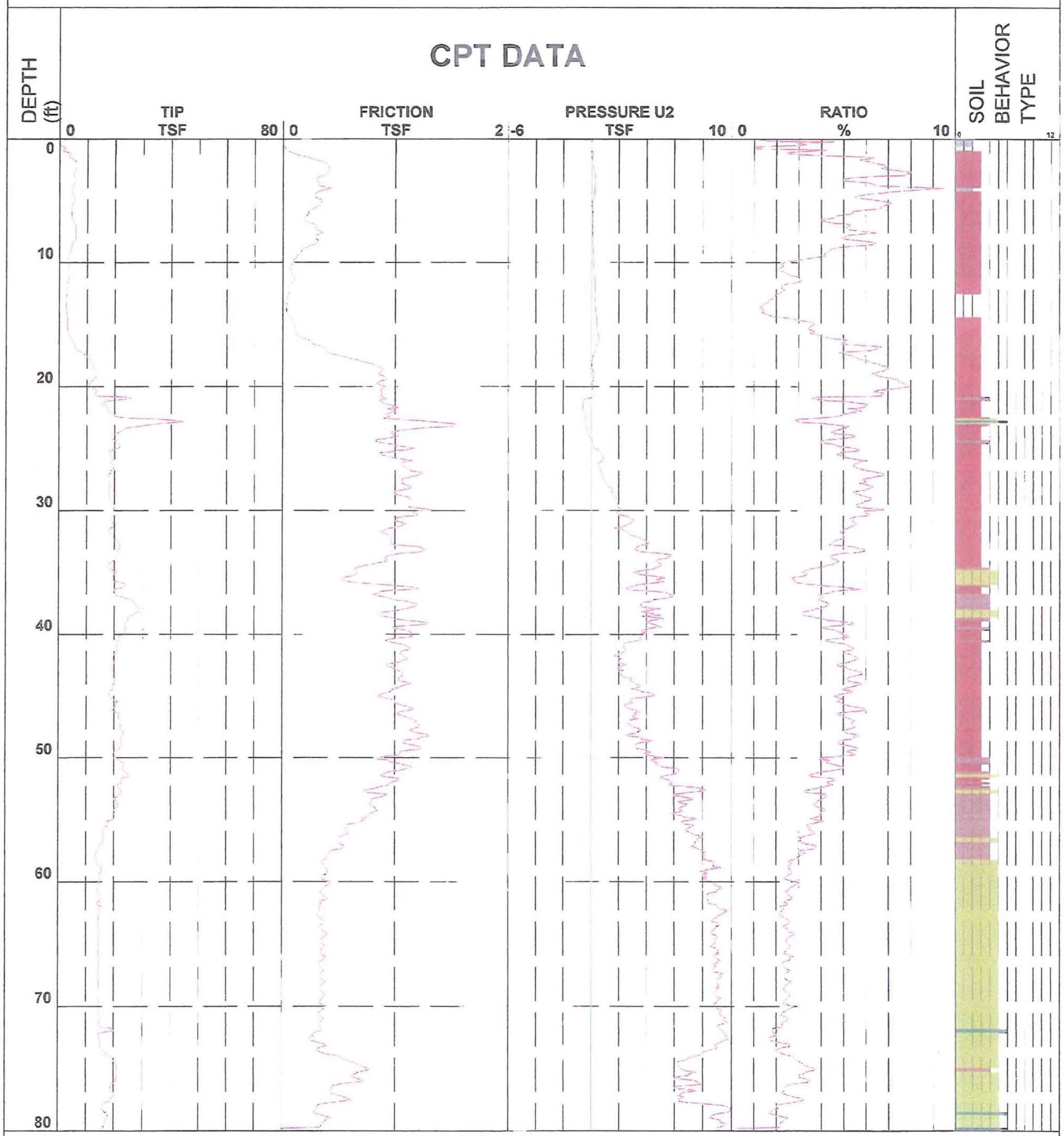
Robertson et al. 1986 * Overconsolidated or Cemented

CPT Data

Job Number 04.1909-0001 | CPT Number OCPT5 | Location Gulfco-Freeport-TX

Operator Albert Fonseca | Date and Tir 07-Jan-2009 10:20:32 | Cone Number F7.5CKEHW2/B0390

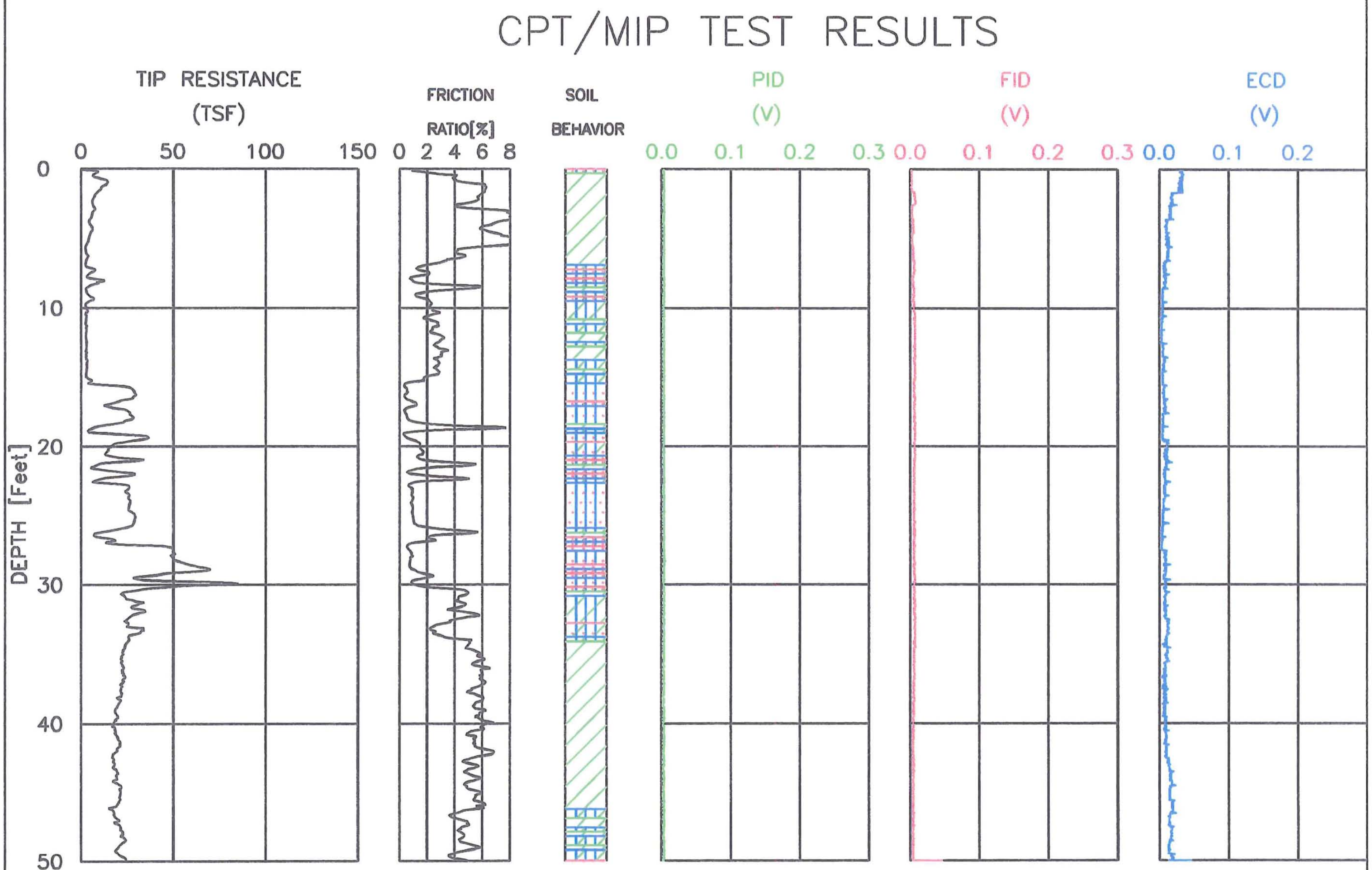
Client Pastor, Behling & Wheeler, LLC



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented

076995



JOB NUMBER: 04.1908-0042

ELEVATION: 0.00

CPT NUMBER: NG3-CPT1

CONE NUMBER: A15F2.5CKEHW1636

DATE: 03-Jun-2008

PLATE: 1 OF 2

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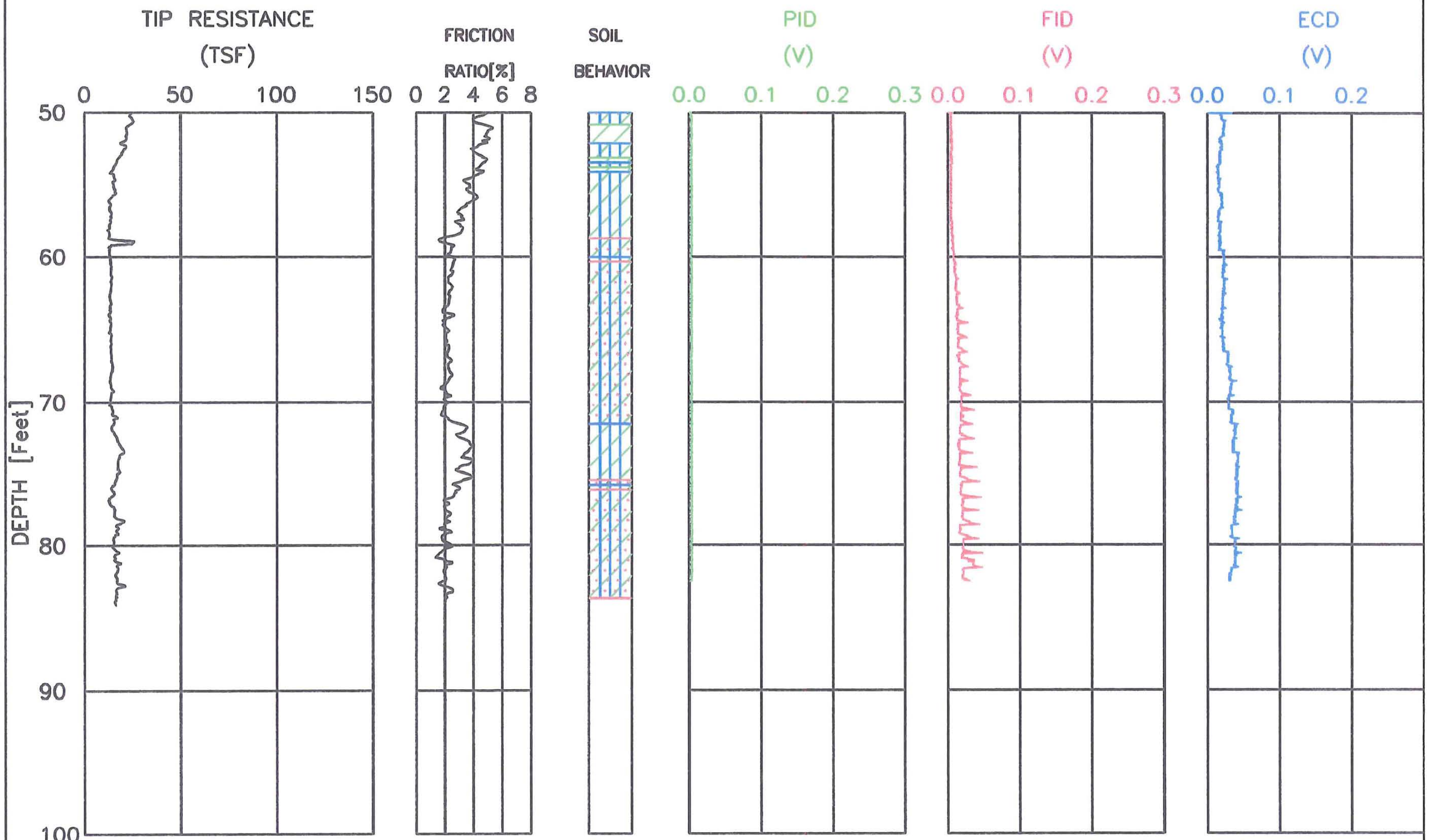
076996

CPT/MIP TEST RESULTS



JOB NUMBER: 04.1908-0042

ELEVATION: 0.00

CPT NUMBER: NG3-CPT1

CONE NUMBER: A15F2.5CKEHW1636

DATE: 03-Jun-2008

PLATE: 2 OF 2

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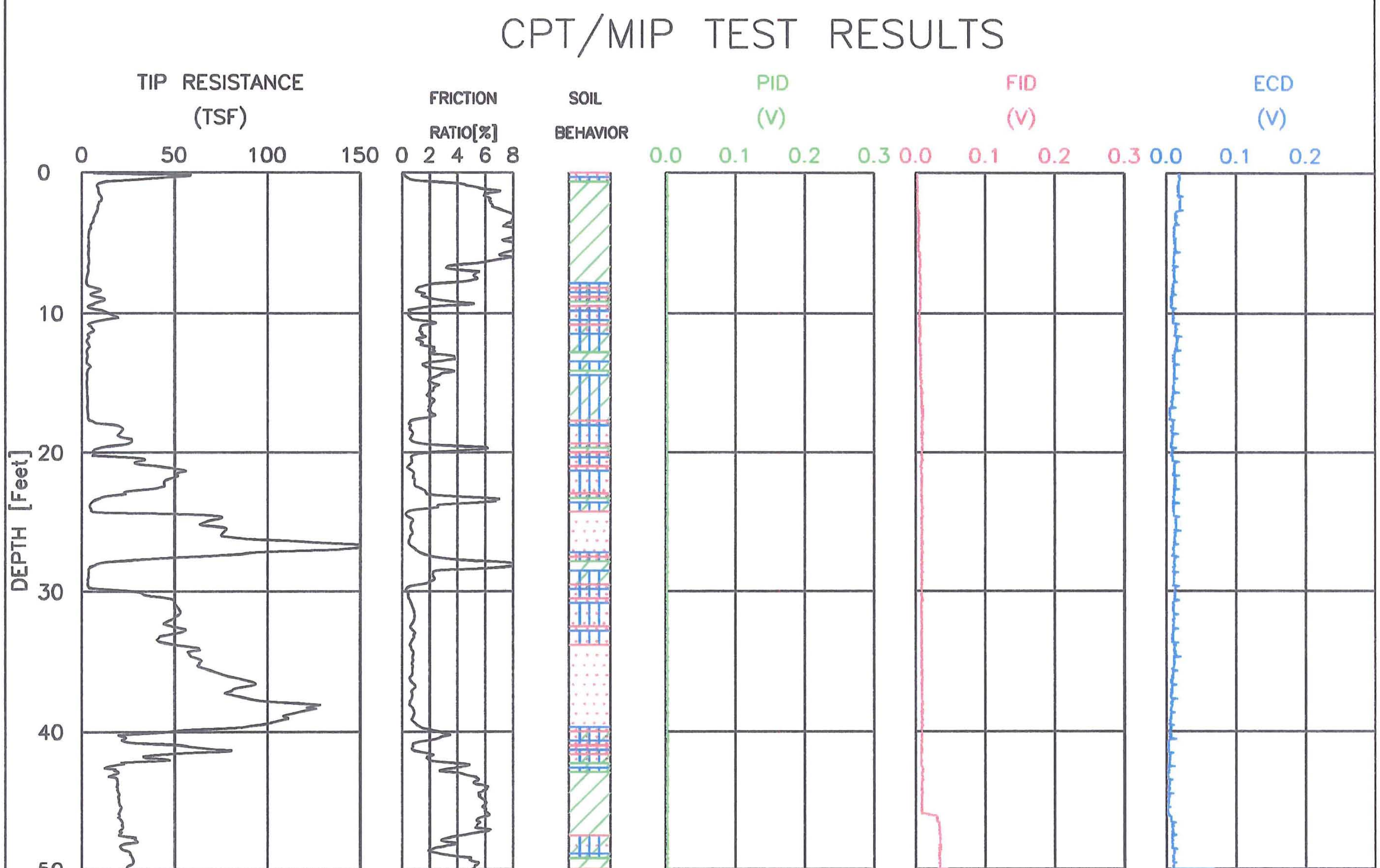
076997



JOB NUMBER: 04.1908-0042

ELEVATION: 0.00

CPT NUMBER: NE4-CPT2

CONE NUMBER: A15F2.5CKEHW1636

DATE: 04-Jun-2008

PLATE: 1 OF 2

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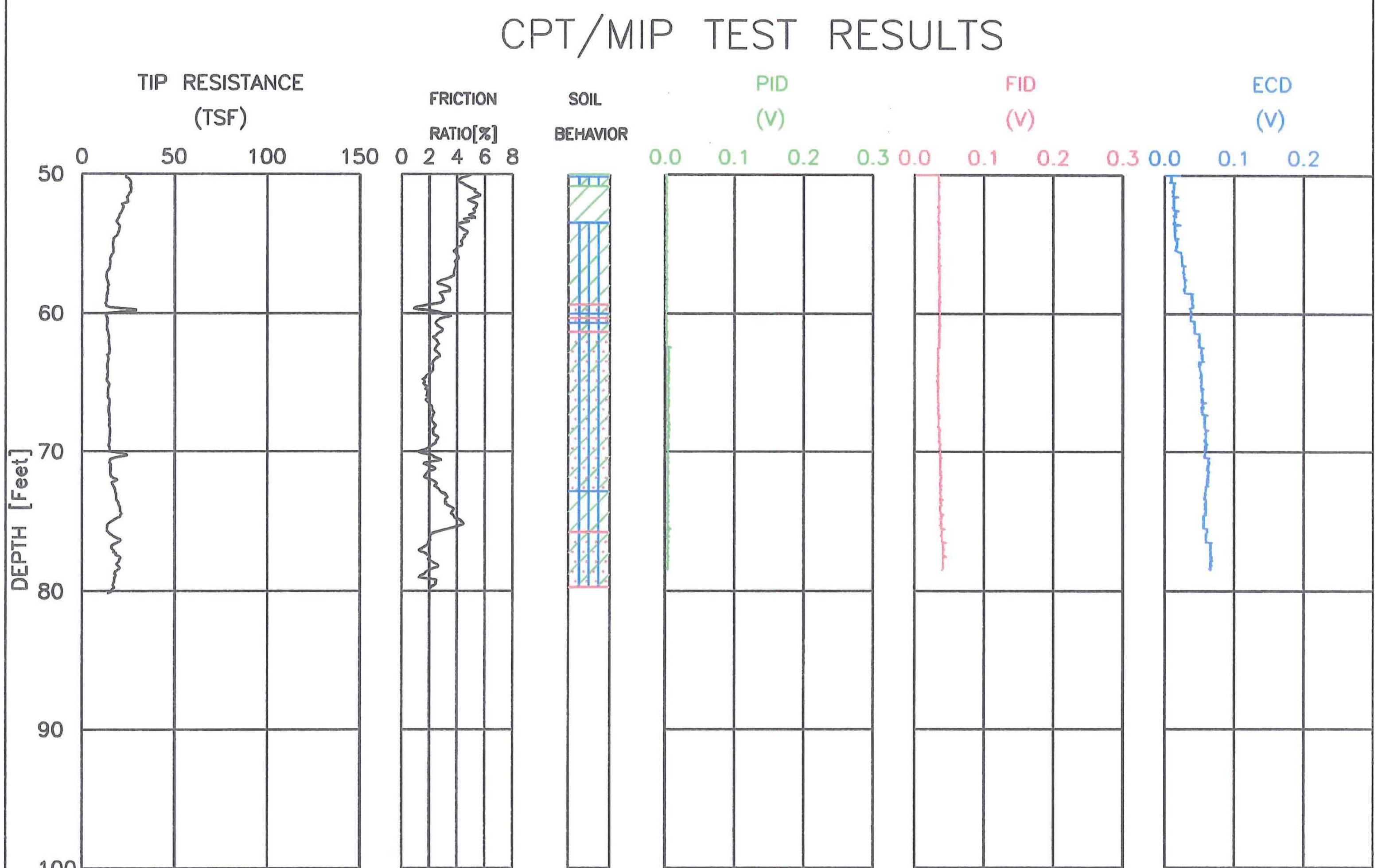
076998



JOB NUMBER: 04.1908-0042

ELEVATION: 0.00

CPT NUMBER: NE4-CPT2

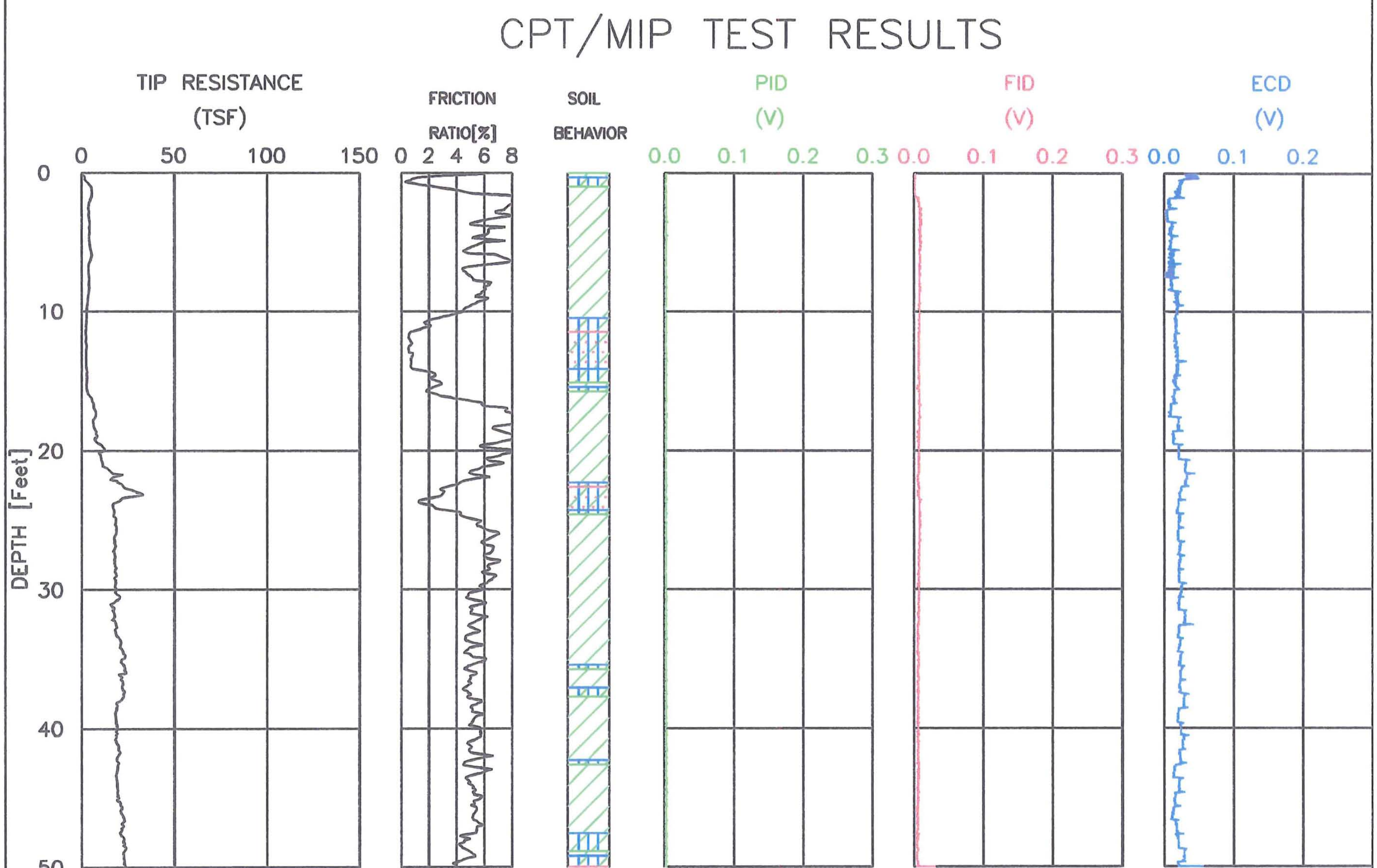
CONE NUMBER: A15F2.5CKEHW1636

DATE: 04-Jun-2008

PLATE: 2 OF 2

FUGRO GEOSCIENCES,INC

076999



JOB NUMBER: 04.1908-0042

ELEVATION: 0.00

CPT NUMBER: NC2-CPT3

CONE NUMBER: A15F2.5CKEHW1636

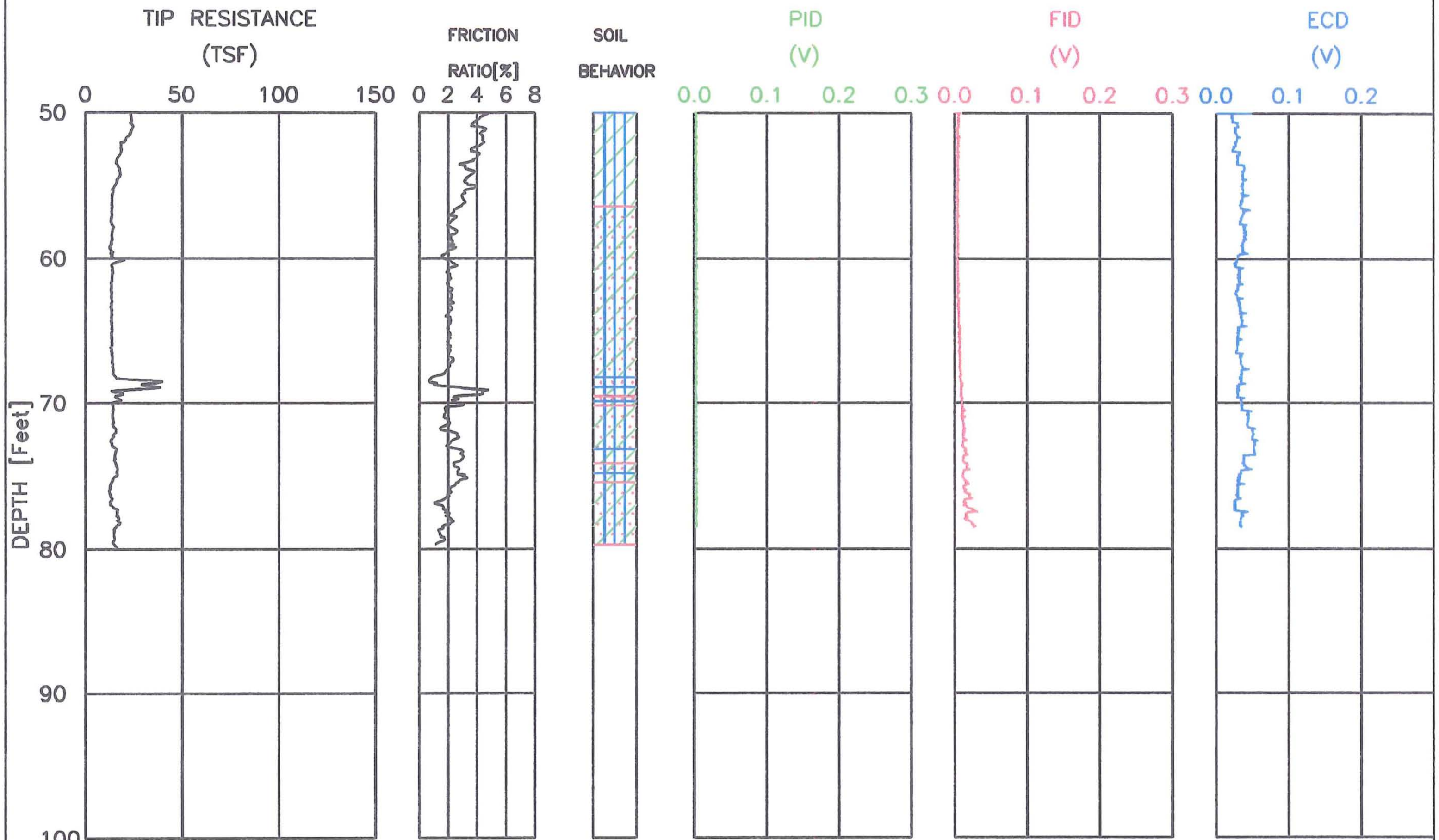
DATE: 02-Jun-2008

PLATE: 1 OF 2

FUGRO GEOSCIENCES,INC

077000

CPT/MIP TEST RESULTS



JOB NUMBER: 04.1908-0042

ELEVATION: 0.00

CPT NUMBER: NC2-CPT3

CONE NUMBER: A15F2.5CKEHW1636

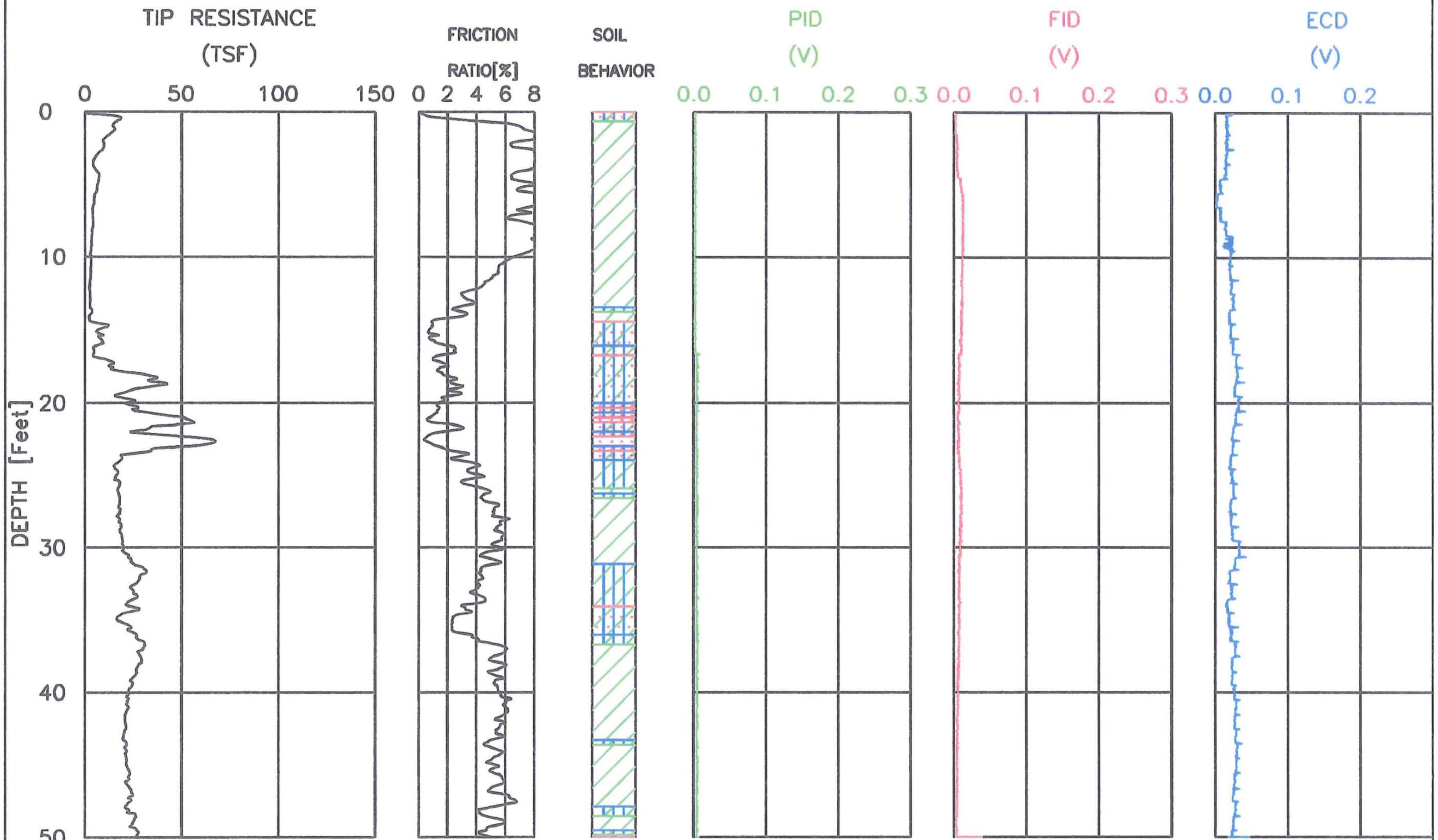
DATE: 02-Jun-2008

PLATE: 2 OF 2

FUGRO GEOSCIENCES,INC

077001

CPT/MIP TEST RESULTS



JOB NUMBER: 04.1908-0042

ELEVATION: 0.00

CPT NUMBER: OCPT-4

CONE NUMBER: A15F2.5CKEHW1636

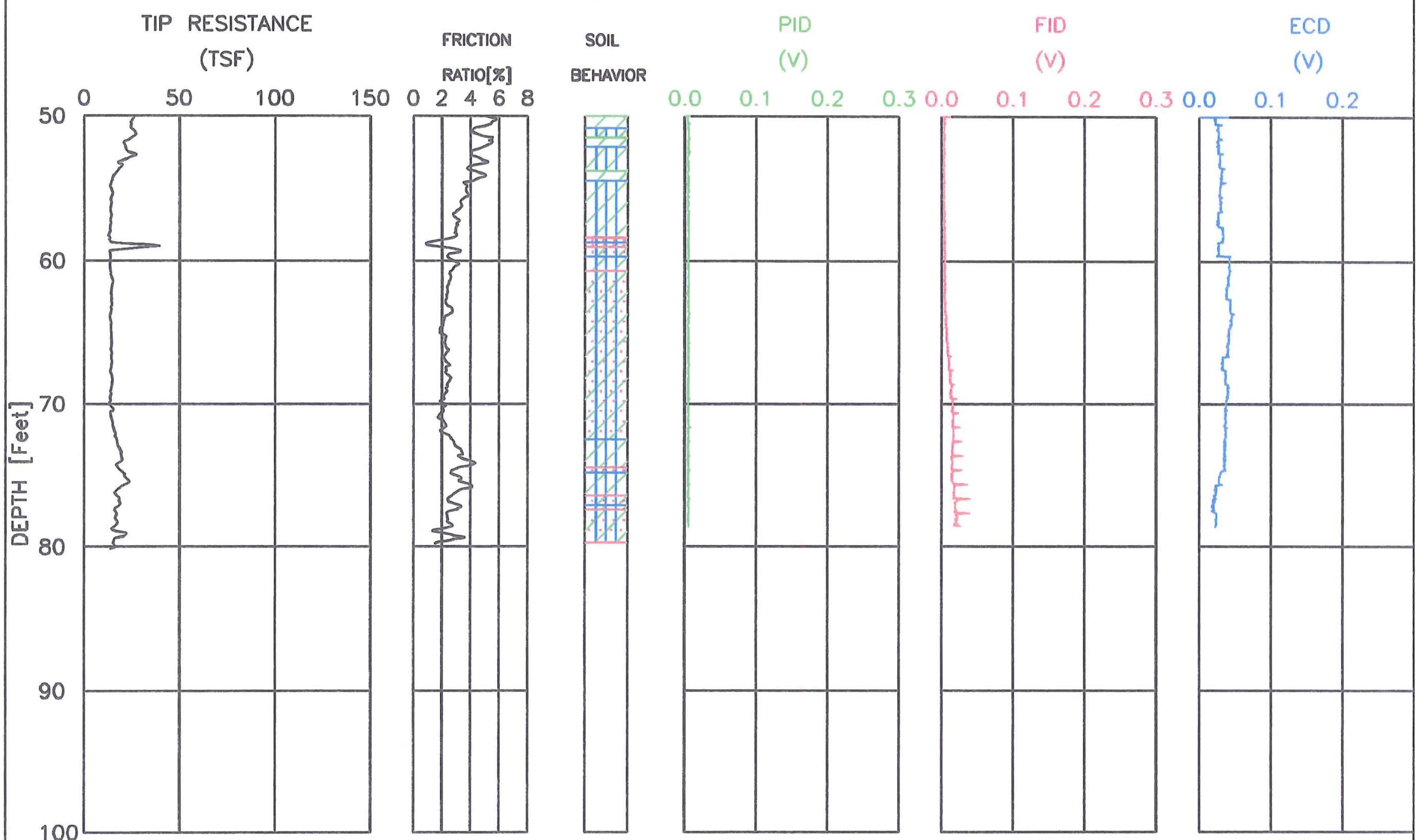
DATE: 03-Jun-2008

PLATE: 1 OF 2

FUGRO GEOSCIENCES,INC

077002

CPT/MIP TEST RESULTS



JOB NUMBER: 04.1908-0042

ELEVATION: 0.00

CPT NUMBER: OCPT-4

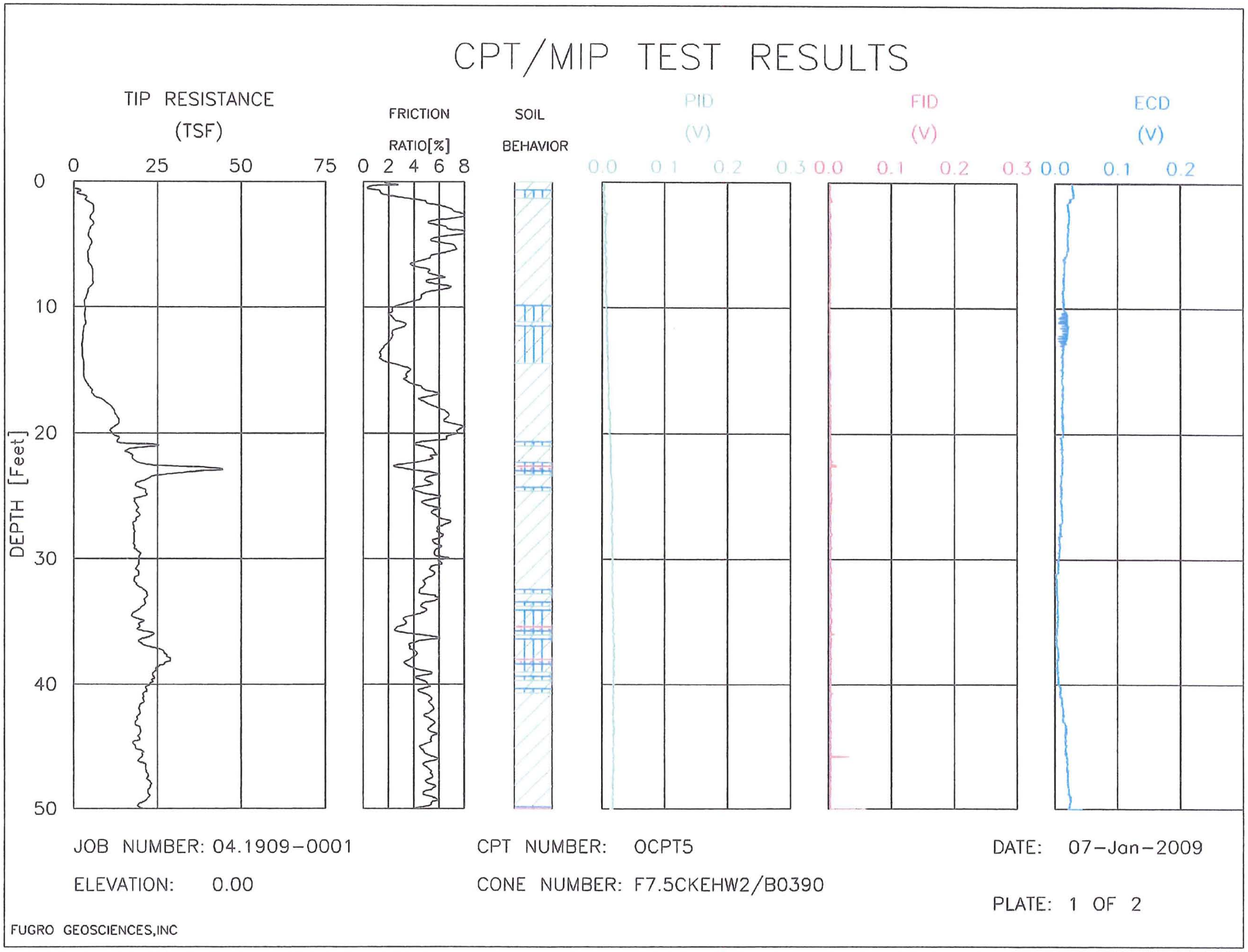
CONE NUMBER: A15F2.5CKEHW1636

DATE: 03-Jun-2008

PLATE: 2 OF 2

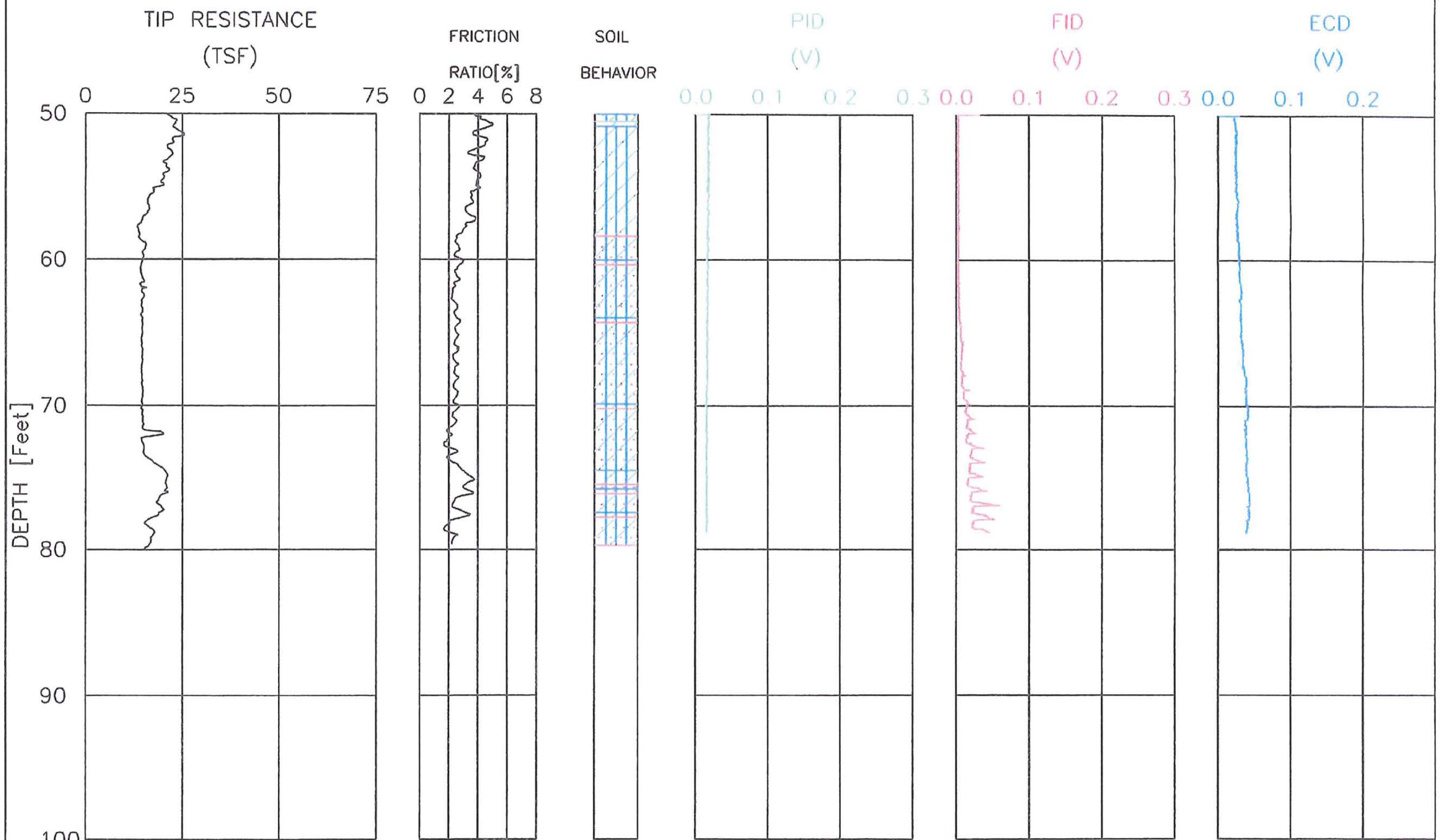
FUGRO GEOSCIENCES,INC

077003


CPT/MIP TEST RESULTS
TIP RESISTANCE
(TSF)
0 25 50 75
FRICTION
RATIO[%]
0 2 4 6 8
SOIL
BEHAVIOR
PID
(V)
0.0 0.1 0.2 0.3
FID
(V)
0.0 0.1 0.2 0.3
ECD
(V)
0.0 0.1 0.2
DEPTH [Feet]
0
10
20
30
40
50
JOB NUMBER: 04.1909-0001
ELEVATION: 0.00
CPT NUMBER: OCPT5
CONE NUMBER: F7.5CKEHW2/B0390
DATE: 07-Jan-2009
PLATE: 1 OF 2
FUGRO GEOSCIENCES,INC

077004

CPT/MIP TEST RESULTS



JOB NUMBER: 04.1909-0001

ELEVATION: 0.00

CPT NUMBER: OCPT5

CONE NUMBER: F7.5CKEHW2/B0390

DATE: 07-Jan-2009

PLATE: 2 OF 2

FUGRO GEOSCIENCES,INC

APPENDIX E

BORING SEIDB01 GEOPHYSICAL LOG

GEO CAM

Borehole ID: SEIDBOI

Logs: GAMMA, SP, RESISTIVITY

Water Well Logging & Video Recording Services

Geo Cam, Inc. 126 Palo Duro, San Antonio, TX 210-495-9121

Project: GULFCO SUPERFUND SITE Date: O6-24-08

Client: **PASTOR, BEHLING, & WHEELER** County: BRAZORIA

Location: N 28°58' 01.7", W 95°17' 20.8" State: TX

BOREHOLE DATA

Drilling Contractor: UNIVERSAL

Driller T.D. (ft): 202'

Elevation:

Logger T.D. (ft) : 201.5'

Depth Ref: G.L.

Date Drilled: 06-24-08

BIT RECORD				CASING RECORD		
RUN	BIT SIZE (in)	FROM (ft)	TO (ft)	SIZE/WGT/THK	FROM (ft)	TO (ft)
1	4"	0'	200'	OPEN		
2						
3						

Drill Method: MUD ROTARY

Weight:

Fluid Level (ft): 5'

Hole Medium:

Mud Type:

Time Since Circ: 40 MIN.

Viscosity:

Rm: at: Deg C

GENERAL DATA

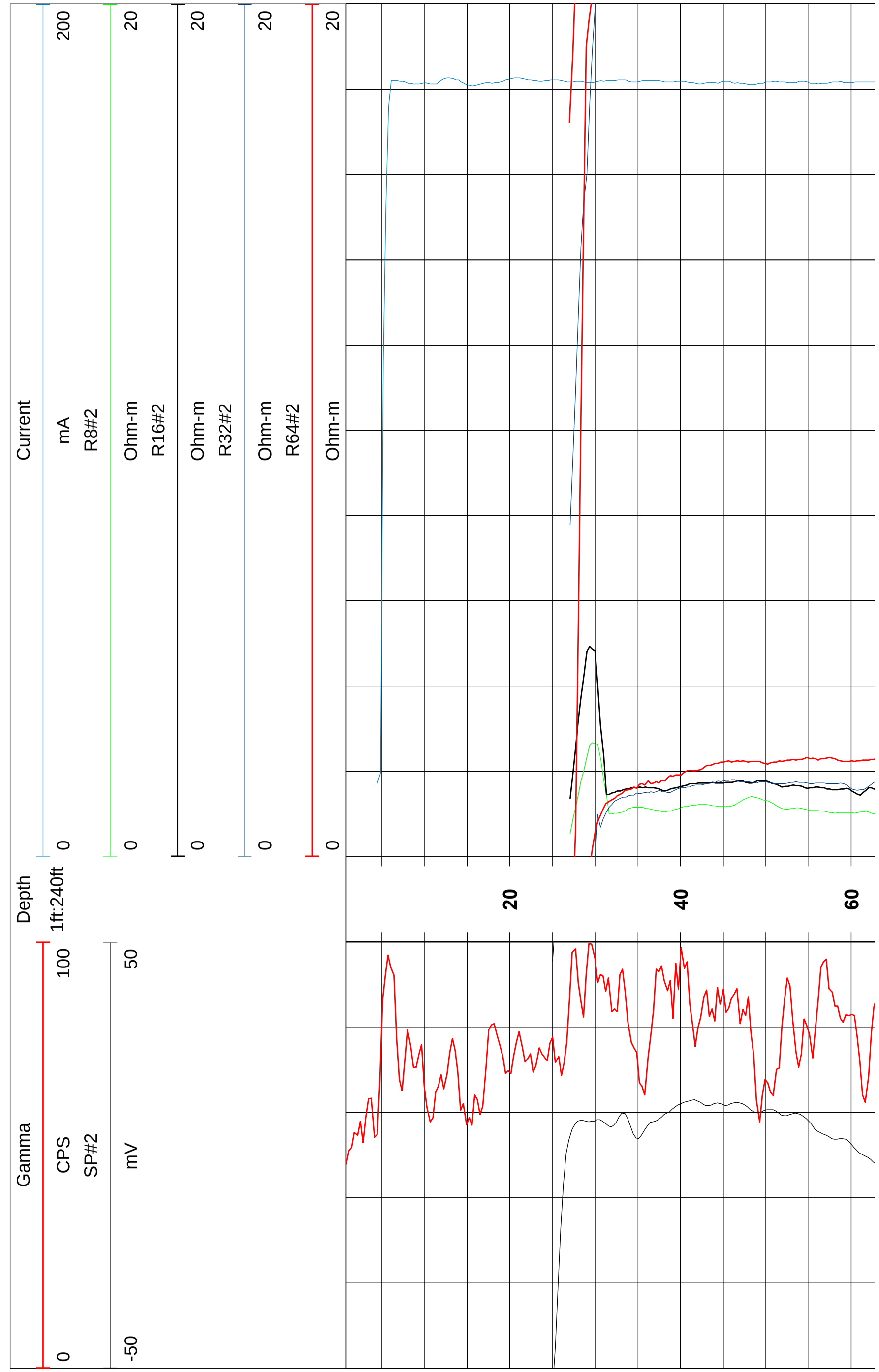
Logged by: Michael G. Miller

Unit/Truck: 03

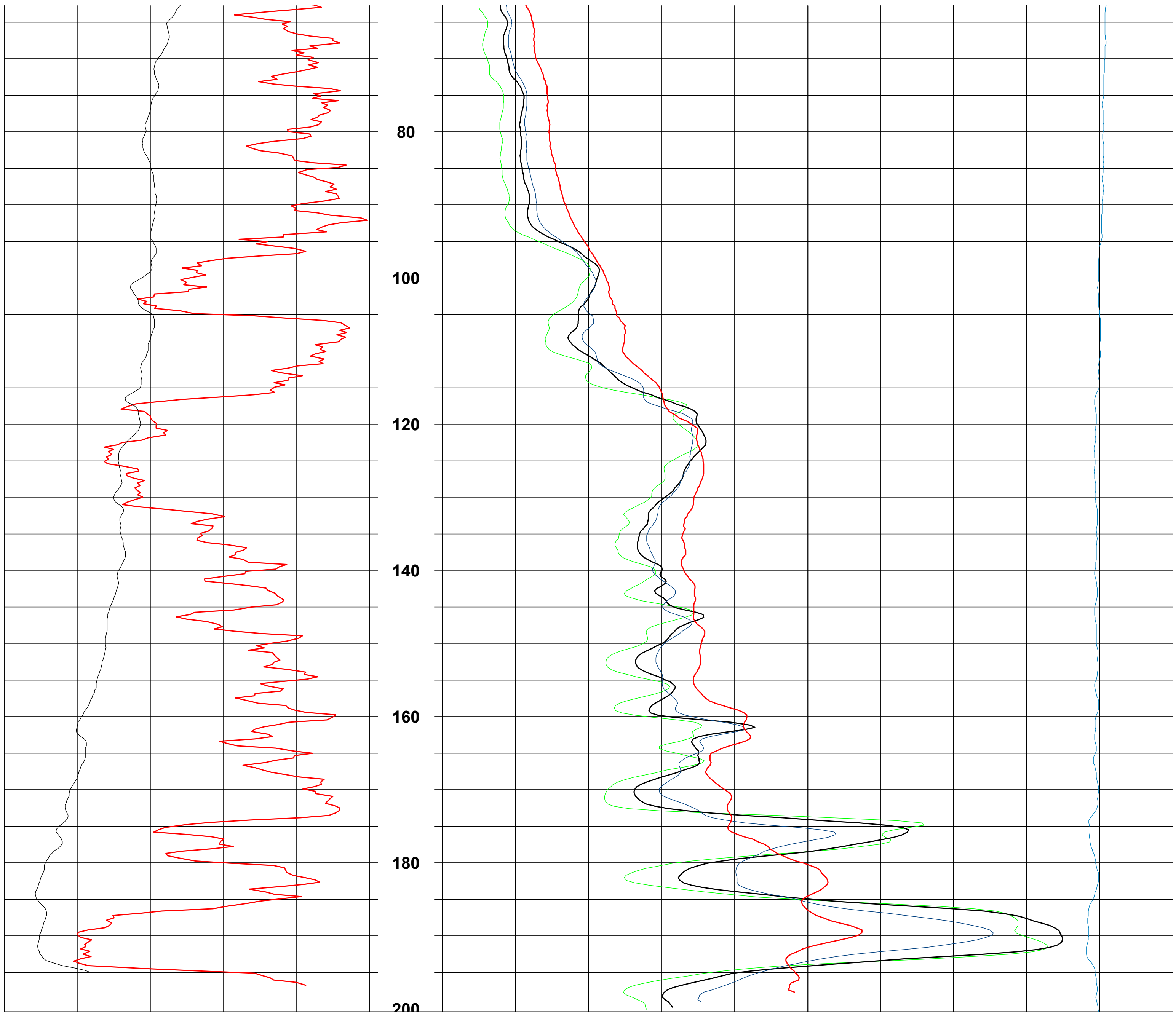
Witness: G. MILLER, E. PASTOR, T. JENNINGS

LOG TYPE	RUN NO	SPEED (ft/min)	FROM (ft)	TO (ft)	FT./ IN.
GAMMA	2	18'	197'	2'	20
SP, RESISTIVITY	2	18'	200'	27'	20

Comments:



077007



077008

APPENDIX F

WATER SUPPLY WELL RECORDS

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Water Well Report™

Wednesday, July 08, 2009

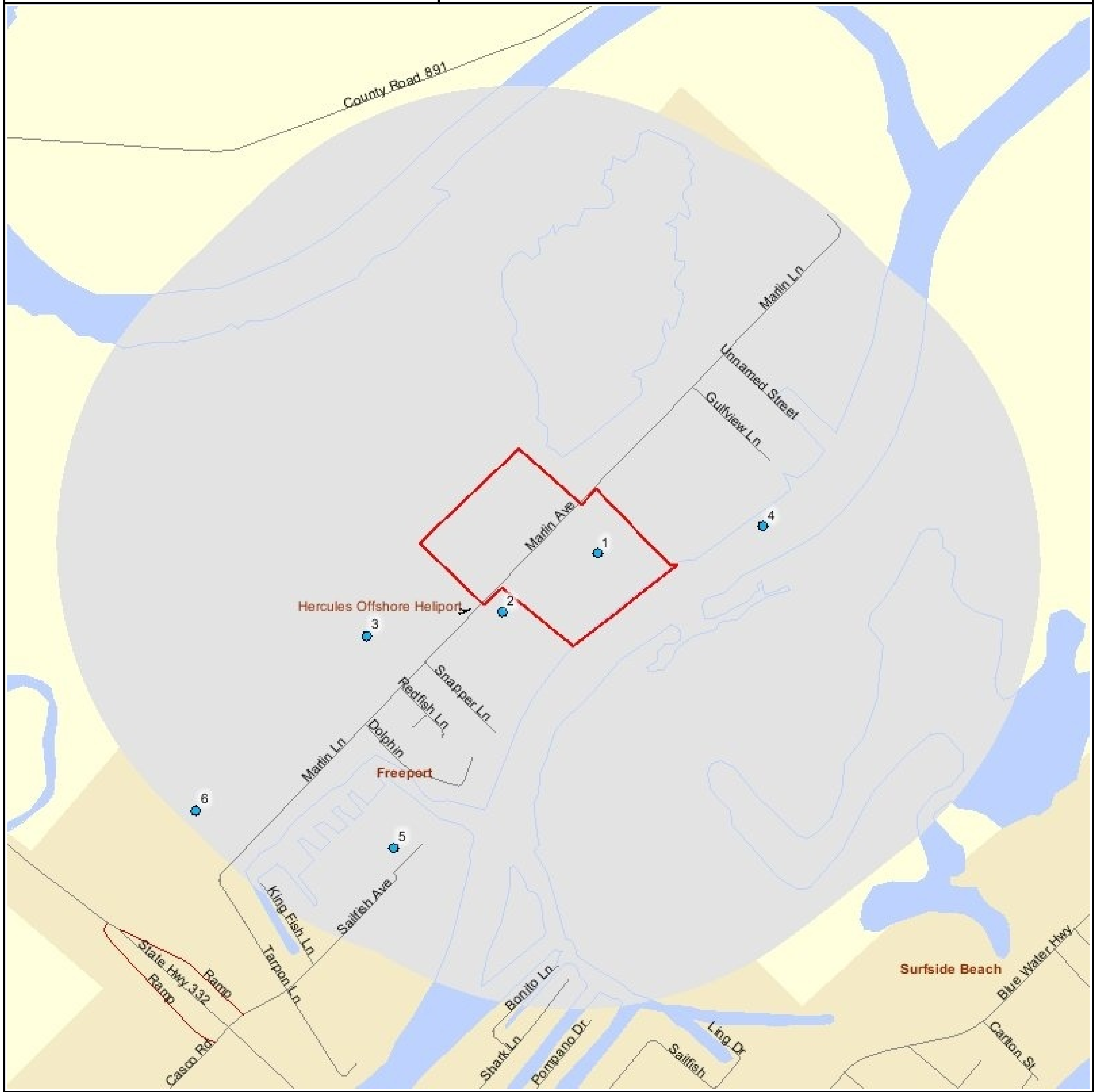
CLIENT
PASTOR, BEHLING & WHEELER, L.L.C. 2201 Double Creek Drive Ste #4004 Round Rock, TX 78664

SITE
Gulfco Marine Maintenance ES53390 Freeport, TX PO #: 1352-R BISMap #: 070809-1902

1601 Rio Grande Suite 500 Austin, Texas 78701
PH 512.478.0059 FAX 512.478.1433 E-mail banks@banksinfo.com

Water Well Report™

Map of Wells within 0.5 Mile(s)



Site	Park	County
Well	School	State
Cluster	Cemetary	Urban Area
Limited Access Hwy	Building	Open Space
Primary Highway	Railroad	Educational/Religious
Secondary Highway	Church	Water Bodies
Roads	Trail	Multihousehold
Hospital	Bridge	Military
Airport	Tower	Custodial Facility

One inch = 0.23 miles

N

Gulfco Marine Maintenance

Banks Environmental Data
1601 Rio Grande Suite 500 Austin, Texas 78701
PH 512-478-0059 FAX 512-478-1433
E-Mail: banks@banksinfo.com

077011

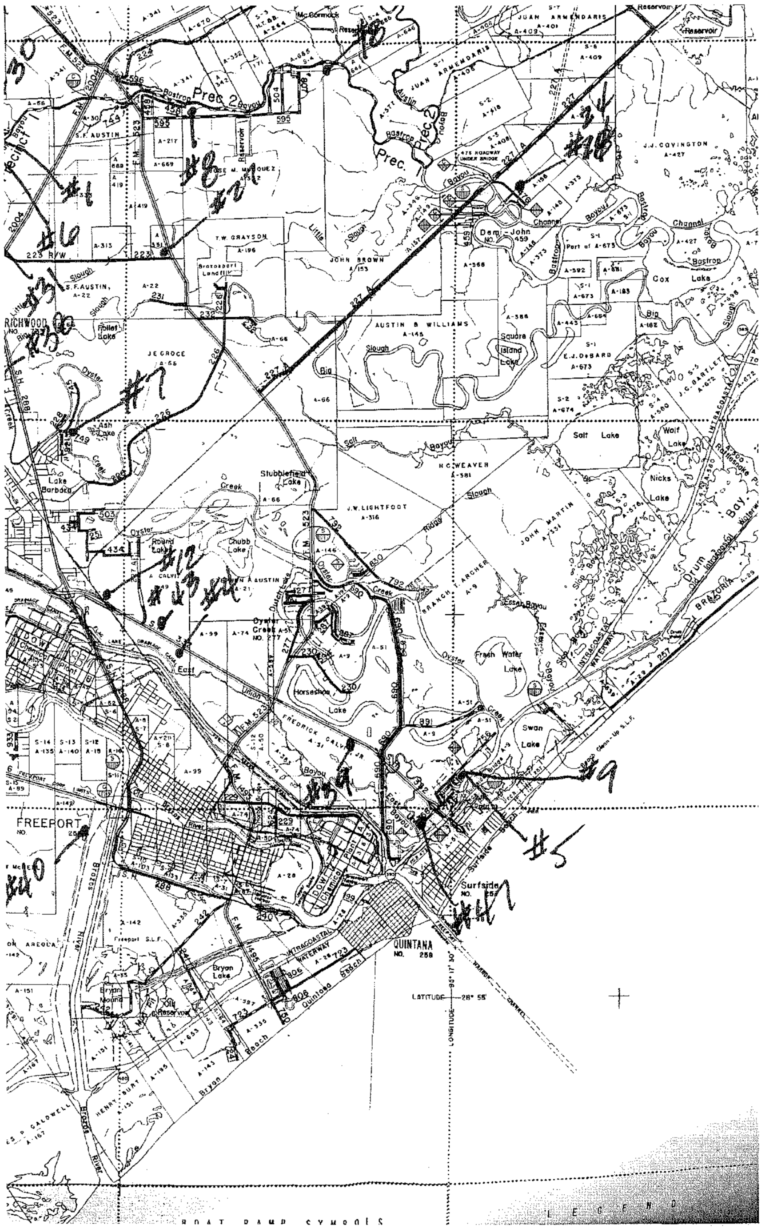
BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Water Well Report™

DETAILS

Map #	State ID	Owner of Well	Type of Well	Depth Drilled	Completion Date	Longitude	Latitude	Driller's Log
1	81-06-3F	A.B. Williamson	Domestic	203	8/4/1980	-95.28756	28.96754	View
2	81-06-303	B.G. Sandelin	PUBLIC SUPPLY	199		-95.28972	28.96638	View
3	81-06-3H	Surf Side Water Works	Domestic	250	11/29/1982	-95.29278	28.96593	View
4	81-06-3E	Surfside Water Works	Public Supply	435	3/3/1982	-95.28384	28.96805	View
5	81-06-3F	B.J Roberts	Domestic	200	9/24/1980	-95.29221	28.96173	View
6	81-06-207	Freeport Marina	PUBLIC SUPPLY	243		-95.29666	28.9625	View

1601 Rio Grande Suite 500 Austin, Texas 78701
PH 512.478.0059 FAX 512.478.1433 E-mail banks@banksinfo.com



5505
13822

65-53-4L

077013

#5

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT
ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 81-06-3F
Located on map YES
Received: RWB

1) OWNER A. B. Williamson (Name) Address 211 Silver Saddle (Street or RFD) Angleton, Texas (City) (State) (Zip)

2) LOCATION OF WELL:
County Brazoria 18 miles in S (N.E., S.W., etc.) direction from Angleton, ~~TExas 77515~~ (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. ____ Block No. ____ Township ____
Abstract No. ____ Survey Name ____
Distance and direction from two intersecting section or survey lines ____

☑ See attached map. ON 65-53-4L

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Other ____

5) DRILLING METHOD (Check): ☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other ____

6) WELL LOG:
Date drilled 8-4-80

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
6¼	Surface	203

7) BOREHOLE COMPLETION:
☐ Open Hole ☒ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other ____
If Gravel Packed give interval . . . from ____ ft. to ____ ft.

From (ft.)	To (ft.)	Description and color of formation material
0	127	clay
127	145	sand .008
145	180	clay
180	194	sand .008
194	203	clay

(Use reverse side if necessary)

13822001

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	To	Gage Casing Screen
4	N	Plastic	0	187	
4	N	Plastic	187	197	.008

CEMENTING DATA
Cemented from ____ ft. to ____ ft.
Method used ____
Cemented by ____ (Company or Individual)

9) WATER LEVEL:
Static level ____ ft. below land surface Date ____
Artesian flow ____ gpm. Date ____

10) PACKERS: Type Depth

11) TYPE PUMP:
☐ Turbine ☐ Jet ☒ Submersible ☐ Cylinder
☐ Other ____
Depth to pump bowls, cylinder, jet, etc., 168 ft.

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☐ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

RECEIVED
AUG 20 1982
CH/TDWR

NAME R. D. Felder (Type or Print) Water Well Drillers Registration No. 1517

ADDRESS P. O. Box 1033 200 Henderson Rd. (Street or RFD) Angleton, TExas 77515 (City) (State) (Zip)

(Signed) R. D. Felder (Water Well Driller) R. Felder Water Well and Pump Serv. (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79) DEPARTMENT OF WATER RESOURCES COPY

077014

WRD Exp. (GW)
April 1966

BH
Well No. 81 - 06 - 303

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

BE 3-9137
CY 7-2688

MASTER CARD

Record by W. SANDEEN Source of data B.L. EVANS Date 4-14-67 Map LAKE JACKSON FREEPORT 1:24,000

State TEXAS 49 County (or town) BRAZORIA B H

Latitude: 29 57 59 N Longitude: 095 17 22 Sequential number: 1

Lat-long accuracy: 1 T. , S, R. , Sec

Local well number: BH 81 06 208 Other number: S & M

Local use: Owner or name: SURFSIDE MARINA B G SANDELIN

Owner or name: B. G. SANDELIN Address:

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist P

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other SUPPLIES WATER FOR USE AT MARINA C

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed W

PW YC

DATA AVAILABLE: Well data Freq. W/L meas.: 4-14-67 Φ Field aquifer char.

Hyd. lab. data:

Qual. water data: type: P

Freq. sampling: 4-14-67 Φ Pumpage inventory: yes no period:

Aperture cards: yes

Log data:

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 199 ft 199 Meas. rept RPT accuracy 6

Depth cased (first perf.) 188 ft 188 Casing type: ; Diam. in 4

CU

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other S

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot, (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other H

-59
4-67

Date Drilled: MARCH 1966 966 Pump intake setting: ft

Driller: HARVEY BACK name ANGLETON address

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other S Deep Shallow
1 STAGE 1 [illegible]

Power (type): diesel, elec, nat gas, gasoline, hand, LP gas, wind; H.P. 3 T Trans. or meter no.

Descrip. MP Top 4" CASING THRU VENT 1.7 ft above/below LSD Alt. MP

Alt. LSD: 4 4 Accuracy: (source) 5' TOPO 3

TAPE
SWL

Water Level 65.04 ft above/below MP ft above/below LSD 63 Accuracy: TAPE 4

Date meas: 4-14-67 467 Yield: gpm Method determined

Drawdown: ft Accuracy: Pumping period hrs

QUALITY OF WATER DATA: Iron ppm Sulfate ppm Chloride ppm Hard. ppm

Sp. Conduct K x 10⁶ Temp. °F Date sampled

Taste, color, etc.

077015

Well No. BH 81-06-303

Latitude-longitude ____ d m s N d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD | Physiographic Province: / | 0 3 | Section:

F | Drainage Basin: | 5 2 B | Subbasin:

Type of well site: (D) depression, (C) stream channel, (N) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (O) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat | F

MAJOR AQUIFER: system, series | Q C | aquifer, formation, group | C U

Lithology: | Origin: | Aquifer Thickness: ft

Length of well open to: 10 ft | 1 0 | Depth to top of: 188 ft | 1 8 8

MINOR AQUIFER: system, series | aquifer, formation, group

Lithology: | Origin: | Aquifer Thickness: ft

Length of well open to: ft | Depth to top of: ft

Intervals Screened: 188 - 198

Depth to consolidated rock: ft | Source of data:

Depth to basement: ft | Source of data:

Surficial material: | Infiltration characteristics:

Coefficient Trans: gpd/ft | Coefficient Storage:

Coefficient Perm: gpd/ft²; Spec cap: gpm/ft; Number of geologic cards:

Well No.

GPO 857-700

077016

Geological Survey 106470

UNITED STATES DEPARTMENT OF THE INTERIOR
Ground Water Analysis

KEY PUNCHED

Water Resources Division
Austin, Texas

State: Texas 4 8 County: Brazoria B H Well No. Latitude 2 8 5 7 5 9 N Longitude 0 9 5 1 7 2 2 Seq. No. 1 Date M D Y 0 4 1 4 6 7 Sampling Depth Type

Local Well No. BH 81-06-~~203~~ 303 Location 6 miles E. of Freeport, Texas Copy to; B.H. Sandelin, Gulfside Marina, P.O. Box 844, Freeport, Tex. 77541

Owner: B.H. Sandelin Date drilled: 1966 Depth ~~400~~ 199 Prod. intervals 188-199 Water level 65.04 4-14-67

Sampled after pumping 15 min. Yield 60 est Pt. of coll. hydrant from well Appearance Use Com. Collector W. Sandeen

Field	Value	ppm	epm
K x 10^6, R KCl 350, R sample 141	2480		
pH	7.4		
Temperature °F			
Density at 20°C			
SiO_2 5 ml, sample .615	16		
Al			
Fe			
Ca 50 ml, 3.0	30		1.50
Mg	22		1.81
Na 1→10, 49.6	496		21.58
Na + K Calc.			
K 1→2, 3.0	6.0		.15
Percent error 1.9 / Total cations			25.04

Field	Value	ppm	epm
HCO_3 25 ml, 15.90	636		10.42
Total Alk as CO_3 313			
CO_3 25 ml	0		.00
SO_4 10 ml, Sample .04	8		.02
Cl 498, 5 ml	498		14.05
Source 1 / Card No. 8			
F 10 ml, A sample 1.220	1.0		.05
NO_3 0.0 ml std. 10 ml	.0		.00
NO_2			
PO_4			
Total anions .80			24.54

Equivalents per million .50 / 47.5

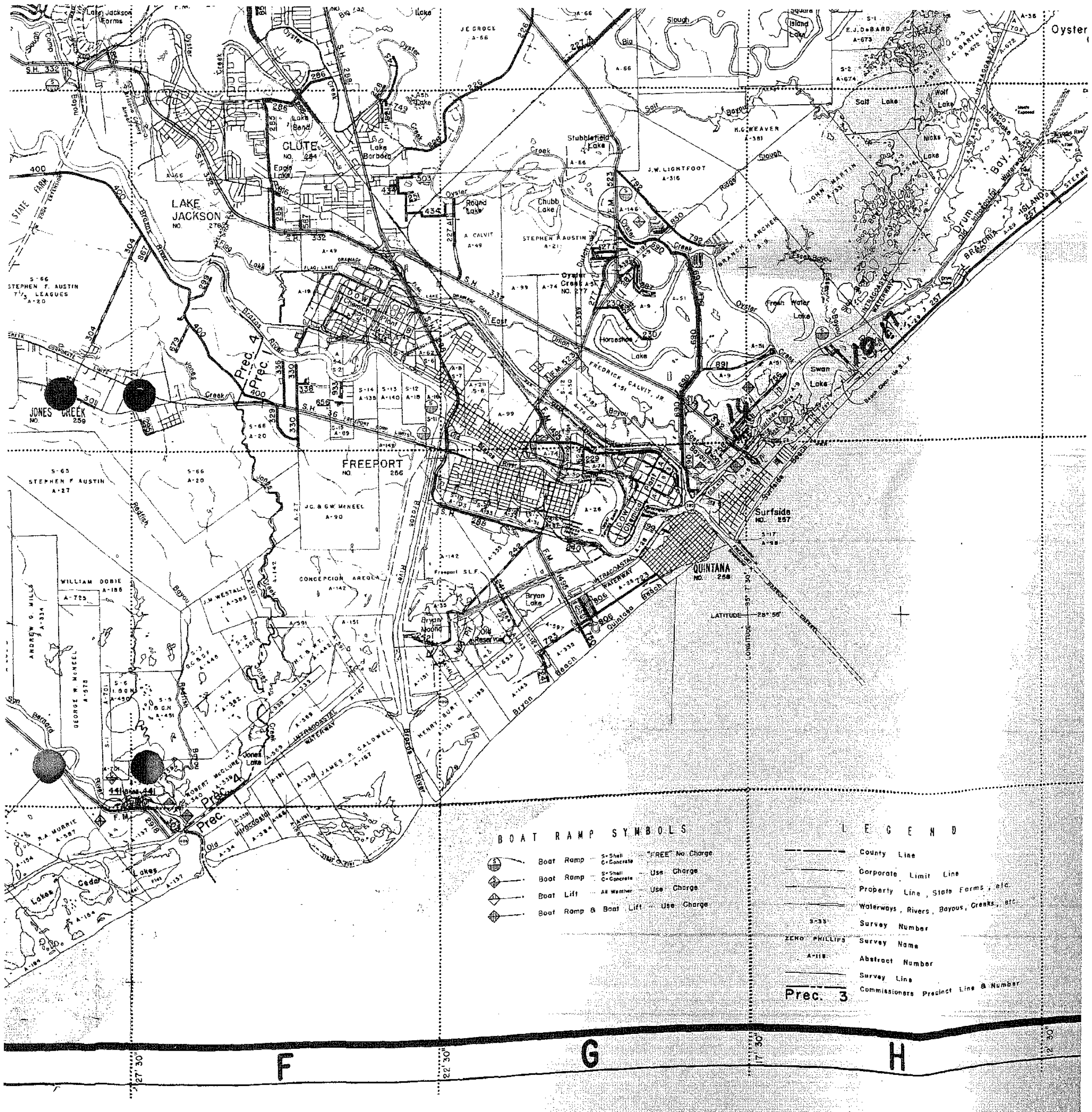
Field	Value
Dissolved solids: Calculated	1380
Hardness: epm Ca + Mg 3.31, epm Alk 10.42	Ca+Mg 166
NCH	0
Card No.	2
Percent Na	86
SAR	17
RSC	7.11
Card No.	5

Analyst / Checked by
Date begun MAY 19 1967 Completed MAY 31 1967

Transmittals	Date
Records processing	
Collector	JUL 12 1967
Owner	JUL 12 1967

Recorded by: Punched by: Date:

077017



5506 13817 65-60-6P

16

Send original copy by certified mail to the Texas Water Development Board P. O. Box 13087 Austin, Texas 78711

State of Texas

WATER WELL REPORT

For TWDB use only
Well No. 81-06-3H
Located on map yes
Received: c.f.s.

1) OWNER:
Person having well drilled Surf Side Water Works (Name) Address 332 RD. (Street or RFD) Surf Side (City) Tx (State)

Landowner Surf Side Water Works (Name) Address 332 RD. (Street or RFD) Surf Side (City) Tx (State)

2) LOCATION OF WELL:
County Brazoria, 1 miles in North (N.E., S.W., etc.) direction from Surf Side (Town)

Locate by sketch map showing landmarks, roads, creeks, hiway number, etc.*

map on 65-60-6P

North

(Use reverse side if necessary)

or Give legal location with distances and directions from adjacent sections or survey lines.

Labor ______ League ______
Block ______ Survey ______
Abstract No. ______
(NW¼ NE¼ SW¼ SE¼) of Section ______

3) TYPE OF WORK (Check): New Well ✓ Deepening Reconditioning Plugging

4) PROPOSED USE (Check): Domestic ✓ Industrial Municipal Irrigation Test Well Other

5) TYPE OF WELL (Check): Rotary ✓ Driven Dug Cable Jetted Bored

6) WELL LOG:
Diameter of hole 6 3/4 in. Depth drilled 250' ft. Depth of completed well 250' ft. Date drilled Nov/29/82

All measurements made from 0' ft. above ground level.

From (ft.)	To (ft.)	Description and color of formation material
0	60	Sandy Clay
60	135	Red Clay
135	160	Sand
160	175	Blue Clay
175	200	Red Clay
200	222	Sand Clay
222	240	Sand
240	250	Blue Clay

(Use reverse side if necessary)

9) Casing:
Type: Old New ✓ Steel Plastic ✓ Other
Cemented from ______ ft. to ______ ft.

Diameter (inches)	Setting From (ft.)	Setting To (ft.)	Gage
4"	0'	225	# 40
4"	230'	250'	# 40

10) SCREEN:
Type Plastic
Perforated Slotted ✓

Diameter (inches)	Setting From (ft.)	Setting To (ft.)	Slot Size
4"	225'	230'	.010

7) COMPLETION (Check):
Straight wall ✓ Gravel packed Other
Under reamed Open Hole

8) WATER LEVEL:
Static level 40' ft. below land surface Date Nov/30/82
Artesian pressure ______ lbs. per square inch Date ______
Depth to pump bowls, cylinder, jet, etc., 130' ft. below land surface.

130' Pump Set

11) WELL TESTS:
Was a pump test made? Yes No ✓ If yes, by whom?
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.
Bailer test ______ gpm with ______ ft. drawdown after ______ hrs.
Artesian flow ______ gpm Jetted
Temperature of water 69°

12) WATER QUALITY:
Was a chemical analysis made? Yes No ✓
Did any strata contain undesirable water? Yes No ✓
Type of water? Good depth of strata 18'

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME B.L. Finch (Type or Print) Water Well Drillers Registration No. 598

ADDRESS P.O. Box 508 (Street or RFD) Sweeny (City) Tx (State)

(Signed) B.L. Finch (Water Well Driller) Finch Water Well (Company Name)

RECEIVED
AUG 31 1983

Please attach electric log, chemical analysis, and other pertinent information, if available.

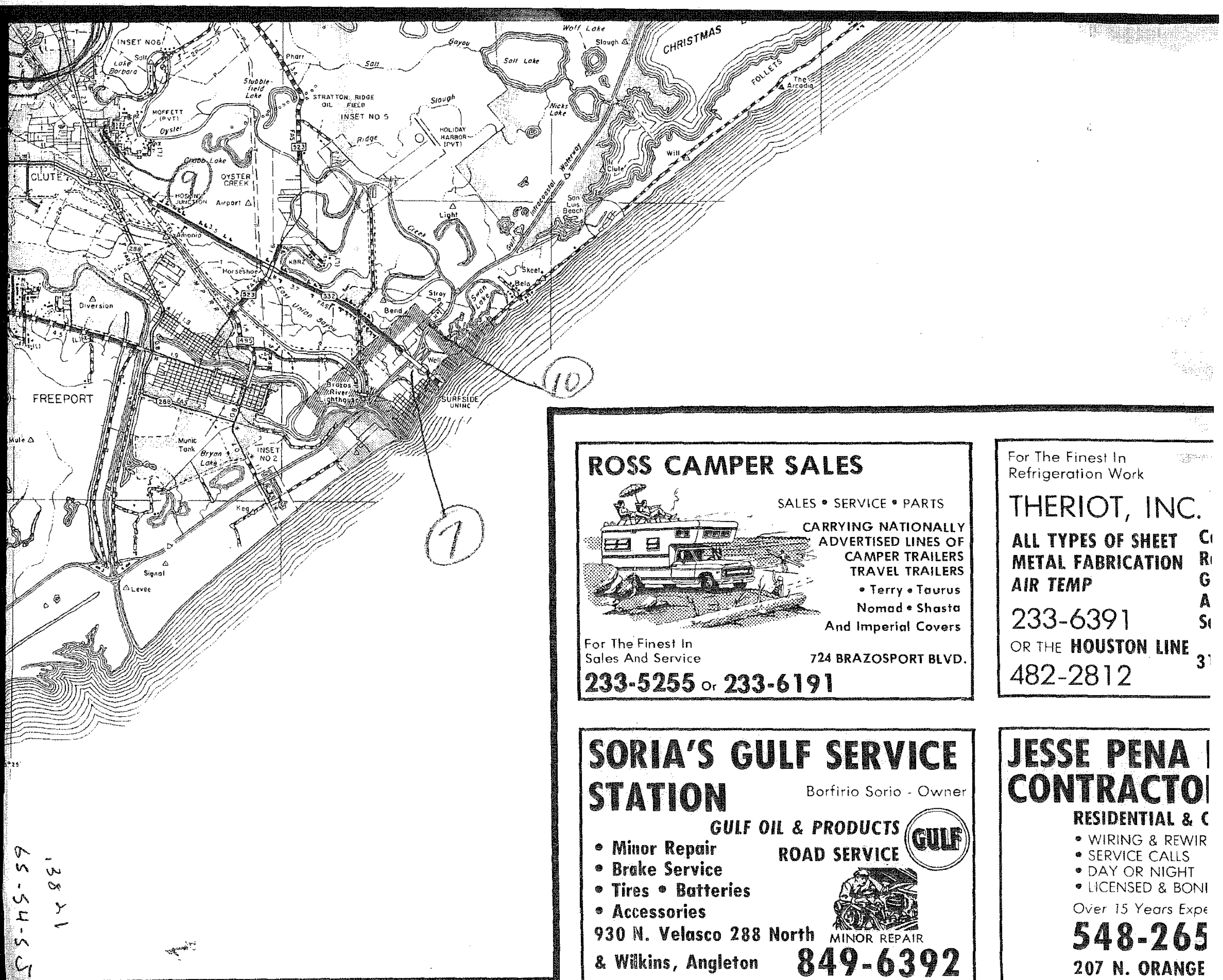
*Additional instructions on reverse side.

TWDB-WD-6

DEPT. OF WATER RESOURCES

4403905506

077019


INSET NO 6
Lake Barbara
MOFFETT (PVT)
Oyster
CLUTE
Crabb Lake
OYSTER CREEK
Airport
Stubble-field Lake
STRATTON RIDGE OIL FIELD
INSET NO 5
Ridge
Slough
HOLIDAY HARBOR (PVT)
Salt Lake
Wolf Lake
CHRISTMAS
FOLLETTS
The Arcadia
Nicks Lake
Clute
San Luis Beach
Light
Horseshoe
Diversion
FREEPORT
Bend
Skeet
Brazos River
SURFSIDE
Mule
Bryan Lake
INSET NO 2
Signal
Levee
9
10
7

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 81-06-3F
Located on map YES
Received: C.F.S.

1) OWNER SURFSIDE WATER WORKS (Name) Address BLUE WATER Hwy (Street or RFD) SURFSIDE (City) TEXAS (State) (Zip)

2) LOCATION OF WELL: County BRAZORIA 1 miles in N.E. (N.E., S.W., etc.) direction from SURFSIDE (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. ______ Block No. ______ Township ______
Abstract No. ______ Survey Name ______
Distance and direction from two intersecting section or survey lines ______

#10 ☑ See attached map. WAPAN 65-34-50

3) TYPE OF WORK (Check): ☑ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Domestic ☐ Industrial ☑ Public Supply ☐ Irrigation ☐ Test Well ☐ Other ______

5) DRILLING METHOD (Check): ☑ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other ______

6) WELL LOG:

Date drilled 3-3-82

DIAMETER OF HOLE Dia. (in.)	From (ft.)	To (ft.)
6 3/4	Surface 0	435

7) BOREHOLE COMPLETION: ☐ Open Hole ☑ Straight Wall ☐ Underreamed ☐ Gravel Packed ☐ Other ______
If Gravel Packed give interval . . . from ______ ft. to ______ ft.

From (ft.)	To (ft.)	Description and color of formation material
0	10	SAND
10	145	BLUE CLAY
145	155	SAND
155	170	BLUE CLAY
170	180	SAND
180	284	Red CLAY
284	300	SAND
300	390	Red CLAY
390	435	SAND

(Use reverse side if necessary) 39745

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4	N	PLASTIC	0	405	
4	N	PLASTIC	405	435	.010

9) CEMENTING DATA
Cemented from (TOP TEN) ft. to ______ ft.
Method used PUMP
Cemented by John R. Brown (Company or Individual)

WATER LEVEL:
Static level 28 ft. below land surface Date 3-5-82
Artesian flow ______ gpm. Date ______

10) PACKERS: Type Depth
2 Rubber 380 / 400

11) TYPE PUMP: ☐ Turbine ☐ Jet ☑ Submersible ☐ Cylinder ☐ Other ______
Depth to pump bowls, cylinder, jet, etc., 210 ft.

12) WELL TESTS: ☐ Type Test: ☐ Pump ☐ Bailer ☑ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☑ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☑ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME JOHN R. BROWN (Type or Print) Water Well Drillers Registration No. 1693

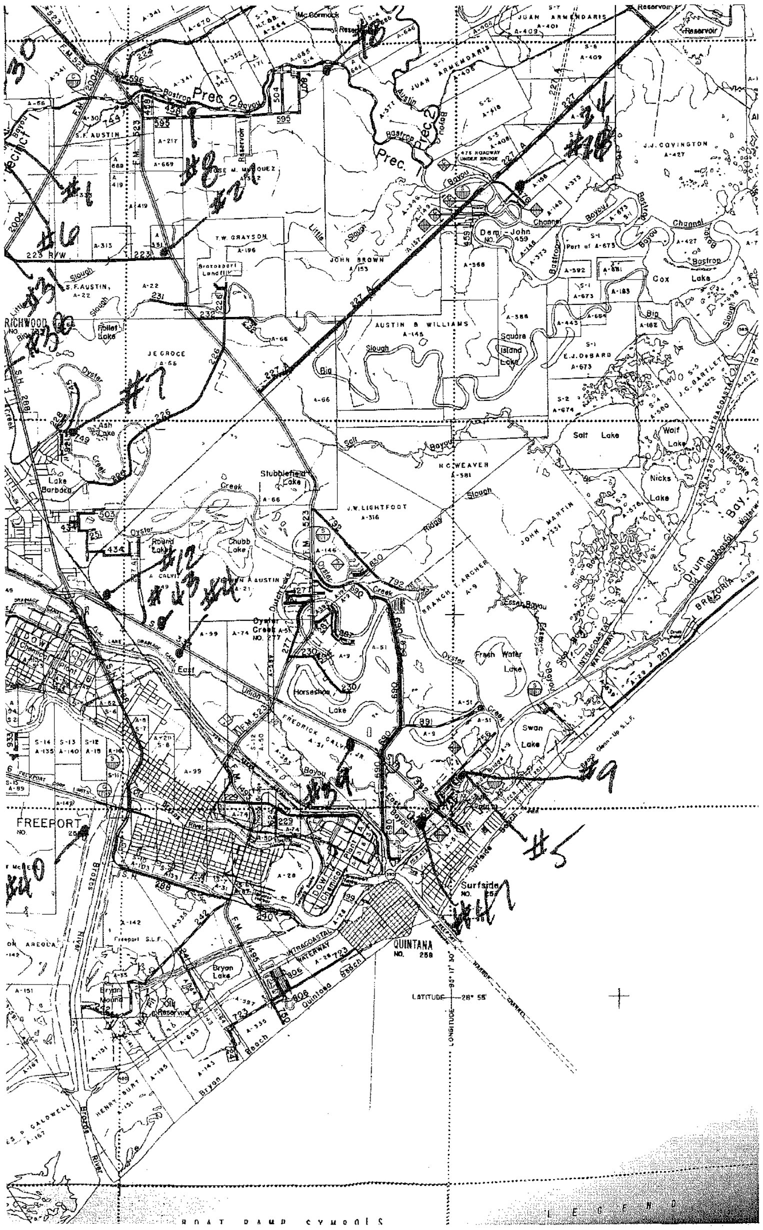
ADDRESS RT 3 BOX 294 (Street or RFD) ANGLETON (City) TEXAS (State) 77515 (Zip)

(Signed) John R. Brown (Water Well Driller) FINCH WATER WELL SERVICE (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79)

DEPARTMENT OF WATER RESOURCES COPY



5505
13822

65-53-4L

9 DUP

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 81-06-3F
Located on map YES
Received: KWB

1) OWNER B. J. Roberts (Name) Address Bridge Harbor (Street or RFD) Freeport, (City) Texas (State) 77541 (Zip)

2) LOCATION OF WELL: County Brazoria 15 miles in S. (N.E., S.W., etc.) direction from Angleton, Texas 77515 (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. ______ Block No. ______ Township ______
Abstract No. ______ Survey Name ______
Distance and direction from two intersecting section or survey lines ______

☒ See attached map. ON 65-53-4L

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Other

5) DRILLING METHOD (Check): ☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other

6) WELL LOG:

Date drilled 9-24-81

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
6½	Surface	200

7) BOREHOLE COMPLETION: ☐ Open Hole ☒ Straight Wall ☐ Underreamed ☐ Gravel Packed ☐ Other
If Gravel Packed give interval . . . from ______ ft. to ______ ft.

From (ft.)	To (ft.)	Description and color of formation material
0	52	clay
52	59	sand
59	102	clay
102	111	sand
111	112	shale
112	118	sand
118	128	clay
128	174	sand with clay
174	182	hard clay
182	200	sand .010

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	To	Gage Casing Screen
4	N	Plastic	0	194	
4	N	Plastic	194	204	.008

CEMENTING DATA

Cemented from ______ ft. to ______ ft.
Method used ______
Cemented by ______ (Company or Individual)

9) WATER LEVEL:
Static level ______ ft. below land surface Date ______
Artesian flow ______ gpm. Date ______

10) PACKERS: Type Depth
Rubber

11) TYPE PUMP: ☐ Turbine ☐ Jet ☒ Submersible ☐ Cylinder ☐ Other ______
Depth to pump bowls, cylinder, jet, etc., 168 ft.

12) WELL TESTS: ☐ Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☐ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

RECEIVED AUG 20 1982 TDWR

NAME R. D. Felder (Type or Print) Water Well Drillers Registration No. 1517

ADDRESS P. O. Box 1033 200 Henderson Rd. (Street or RFD) Angleton, (City) Texas (State) 77515 (Zip)

(Signed) R. D. Felder (Water Well Driller) R. Felder Water Well and Pump Serv. (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79) DEPARTMENT OF WATER RESOURCES COPY 480390330 5

077023

WRD Exp. (GW)
April 1966

Well No. BH 81 06 - 207

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

MASTER CARD

Record by W. SANDEEN Source of data BRUCE PONTON Date 2-28-67 Map FREEPORT, 1964

State TEXAS [4 8] County (or town) BRAZORIA [B H]

Latitude: [ ] Longitude: [0 9 5 1 7 4 7] Sequential number: [1] 6 DM

Lat-long accuracy: [1] T. ___ N, S. R. ___ W. Sec. ___

Local well number: [B H 8 1 0 6 2 0 7] Other number: B & H

Local use: [ ] Owner or name: MARINA VILLAGE BOX 2360

Owner or name: [M A R I N A V I L L A G E] Address: FREEPORT, TEXAS

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist [N]

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) PS, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other — 1 OF 2 WELLS SUPPLYING MOTEL RES. + 16 HOUSES [P]

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed [W]

GWY P/2

DATA AVAILABLE: Well data [ ] Freq. W/L meas.: ___ [N] Field aquifer char. [ ]

Hyd. lab. data: ___ [ ]

Qual. water data; type: ___ [P]

Freq. sampling: 4-14-67 [P] Pumpage inventory: yes no period: ___ [ ]

Aperture cards: ___ yes [ ]

Log data: ___ [ ]

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 243± ft [2 4 3] Meas. Rept. accuracy [6]

Depth cased (first perf.) NA ft [ ] Casing type: ___ ; Diam. 6 in [6]

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other [S]

Method Drilled: (A) air rot., (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other [H]

Date Drilled: 1962± [9 6 2] Pump intake setting: ___ ft [ ]

Driller: CHRISTIE KUHLMAN

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other [S] Deep Shallow [ ]

Power (type): diesel, elec, nat gas, gasoline, hand, LP gas, wind; H.P. ASSUME 1-5 [T] Trans. or meter no.

Descrip. MP PLUG IN 6" CASING + 2.3 ft above below LSD Alt. MP

Alt. LSD: 5± [5] Accuracy: (source) 5' TOPO [3]

Water Level UTM ft above below MP; ft above below LSD [ ] Accuracy: ___ [ ]

Date meas: ___ [ ] Yield: ___ gpm [ ] Method determined [ ]

Drawdown: ___ ft [ ] Accuracy: [ ] Pumping period ___ hrs [ ]

QUALITY OF WATER DATA: Iron ___ ppm [ ] Sulfate ___ ppm [ ] Chloride ___ ppm [ ] Hard. ___ ppm [ ]

Sp. Conduct. ___ K x 10⁶ [ ] Temp. ___ °F [ ] Date sampled [ ] 4-14-67

Taste, color, etc. ___

* OBSTRUCTION AT 21 Feet.

077024

Well No. BH 81-06-207

Latitude-longitude N d m s W d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD | Physiographic Province: | 0 3 | Section:

F | Drainage Basin: | 5 2 B | Subbasin:

Type of well site: (D) depression, (C) stream channel, (S) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (O) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat

MAJOR AQUIFER: system, series Q C aquifer, formation, group C U

Lithology: Origin: Aquifer Thickness: ft

Length of well open to: ft Depth to top of: ft

MINOR AQUIFER: system, series aquifer, formation, group

Lithology: Origin: Aquifer Thickness: ft

Length of well open to: ft Depth to top of: ft

Intervals Screened: NA.

Depth to consolidated rock: ft, Source of data:

Depth to basement: ft Source of data:

Surficial material: Infiltration characteristics:

Coefficient Trans: gpd/ft Coefficient Storage:

Coefficient Perm: gpd/ft^2; Spec cap: gpm/ft; Number of geologic cards:

Well No.

GPO 857-700

077025

Geological Survey 106473

UNITED STATES DEPARTMENT OF THE INTERIOR
Ground Water Analysis

Water Resources Division
Austin, Texas

State: Texas 4 8 County: Brazoria B H Well No. Latitude 2 8 5 7 4 4 N Longitude 0 9 5 1 7 4 7 Seq. No. 1 Date M D Y 0 4 1 4 6 7 Sampling Depth Type G

Local Well No. B H 81-06-207 Location SEND COPY TO: Bruce Ponton, Marina Village, Box 2366, Freeport, Texas. 77541

Owner: Bruce Ponton Date drilled: 1962 Depth 243 WBF Prod. intervals KEY PUNCHED Water level UTM

Sampled after pumping Yield 60 pump est. Pt. of coll. Hudrant out of well Appearance clear Use Com. Collector W. Sandeen

Constituent	Data	ppm	epm
K x 10⁶	R KCl 351, R sample 135	2600	
pH		7.2	
Temperature °F			
SiO_2	5 ml, A sample .505	13	
Al			
Fe			
Ca	25 ml, 1.80	36	1.80
Mg		24	1.97
Na	1→10, 50.9	509	22.14
Na + K Calc.			
K	1→2, 3.0	6.0	.15
Percent error +0.3	Total cations		26.2

Constituent	Data	ppm	epm
HCO_3	25 ml, 14.60; Total Alk as CO_3 281	584	9.57
CO_3	25 ml	0	.00
SO_4	10 ml; Sample .04	0.8	.02
Cl	5.74; 5 ml	574	16.19
Source / Card No.	Card No. 0		
F	10 ml; A sample 1.184	1.1	.06
NO_3	.85 ml std. 10 ml	4.2	.07
NO_2			
PO_4			
Total anions		.80	25.91

Item	Value
B	
Al / Fe / Mn	
Cu / Pb / Zn	
Dissolved solids: Determined	
Dissolved solids: Calculated	1460
Hardness: epm Ca + Mg 3.77; epm Alk 9.57; epm NCH	Ca+Mg 188; NCH 0
Color	Card No. R
Br / I	
Alk. as $CaCO_3$ / Free CO_2	
Percent Na	85
SAR	16
RSC	5.80
MBAS / NO_2	Card No. S

Analyst ISAAC CRAWFORD Checked by

Date begun MAY 1 9 1967 Completed MAY

Transmittals	Date
Records processing	
Collector	JUL 12 1967
Owner	JUL 12 1967

Recorded by: Punched by: Date:

077026

BANKS ENVIRONMENTAL DATA A DIVISION OF THE BANKS GROUP	**Water Well Report™**
	DISCLAIMER

Water Well Report Research Mapping ™
The Banks Environmental Data Water Well Report™ is prepared from existing state water well databases and additional file data/records research conducted at Texas' regulatory authorities. Submission of driller's log records upon completion of a drilled water well became mandatory in 1985. The state of Texas has processed these records into several different filing systems within two state regulatory authorities. The water well files, records and map locations are maintained by the Texas Commission on Environmental Quality (TCEQ) and the Texas Water Development Board (TWDB). Actual water well site locations of this report are geocoded and geoplotted directly from the drilling records, drilling schedules, and driller's logs and maps submitted by the water well driller and maintained at these two primary water well regulatory authorities. Below is a description of the filing systems utilized for well drilling records.

Texas Water Development Board (TWDB)
The Texas Water Development Board maintains two datasets of located water well records:

TWDB Groundwater Data-These well files are water well site locations that have been verified with a field inventory inspection by TWDB personnel. The wells are assigned a State Identification Number unique to that well (ex. 65-03-401) and plotted on county base maps, U.S.G.S. 7.5 minute topographical quadrangle maps, as well as in-house and on line geographic information systems. Records may also include analytical data attached with each drilling record.

TWDB Submitted Drillers Reports- A Database created from the online Texas Well Report Submission and Retrieval System (A cooperative TDLR, TWDB system) that registered water-well drillers use to submit their required reports. Reports that drillers submit by mail are geoplotted/geocoded by a TWDB staff member. These wells are assigned a unique tracking number by the Texas Well Report Submission and Retrieval System. This system was introduced in February 2001 as an option for drillers to use, and will be mandatory in the future.

Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality (TCEQ) maintains two datasets of water well records.

Water Utility Database (WUD) – This database contains a collection of data from Texas Water Districts, Public Drinking Water Systems and Water and Sewer Utilities who submit information to the TCEQ. These wells are assigned unique numbers with correlate to the Public Water System they act as a source for (example- S2200199A, G2200322A). The WUD does not contain Drillers Reports or analytical data. This data was provided to Banks in digital format.

TCEQ Central Records-Several different types of Driller's Reports are filed with TCEQ Central Records according to the State Grid Number.

Plotted water well files are water well site locations that have been determined from map information submitted on water well logs and subsequently plotted on TWDB county highway base maps. The accuracy and location of these wells is relative to the information provided on the drillers report. TWDB assigned letters to the correlating grid number to identify these wells (example – 65-59-1A). In some instances, a single well number can represent more than one well location. This type of mapping and filing procedure ceased in June 1986.

Partially numbered water wells -Well Reports that were provided a State Identification Number by the TWDB which establishes the well location somewhere within a 2.5 minute quadrant of a 7.5 minute quadrangle map. This method was the standard procedure from 1986 through 1991. From 1991 to the 2001, Texas Well Reports contain a grid location box, where drillers are provided a place to mark an X where within the 2.5 minute quadrant is located. These locations have not been verified by the state.

Unnumbered water well files are water well site locations that have been processed since June 1990. These well records are filed solely on their county location and are not provided a State Identifiation Number nor are they mapped.

Disclaimer
Banks Environmental Data has performed a thorough and diligent search of all wells recorded with the Texas Water Development Board and the Texas Commission on Environmental Quality. All mapped locations are based on information obtained from the TWDB and the TCEQ. Although Banks performs quality assurance and quality control on all research projects, we recognize that any inaccuracies of the records and mapped well locations could possibly be traced to the appropriate regulatory authority or the water well driller. Many water well schedules may have never been submitted to the regulatory authority by the water well driller and, thus, may explain the possible unaccountability of private drilled wells. It is uncertain if the above listing provides 100% of the existing well locations within the area of review. Therefore, Banks Environmental Data cannot gaurantee the accuracy of the data or well location(s) of those maps and records maintained by Texas' regulatory authorities.

1601 Rio Grande Suite 500 Austin, Texas 78701
PH 512.478.0059 FAX 512.478.1433 E-mail banks@banksinfo.com

APPENDIX G

INTRACOASTAL WATERWAY SEDIMENT BACKGROUND CONCENTRATION TOLERANCE LIMIT CALCULATIONS

APPENDIX G

INTRACOASTAL WATERWAY SEDIMENT BACKGROUND CONCENTRATION TOLERANCE LIMIT CALCULATIONS

Tolerance limits were calculated for background metals analytes using the procedure described in Gibbons, 1994. Relevant pages from Gibbons, 1994 describing this procedure are attached. A step-by-step discussion of these calculations is provided below.

Step 1 - Calculate the Background Mean and Standard Deviation

After confirming the data were normally distributed, these parameters were calculated for each background metal using EPA's *PRO UCL* statistical software package (EPA, 2007). These parameters are summarized in Table G-1.

Step 2- Calculate Tolerance Limit

Since the purpose of the tolerance limit is to identify metals concentrations that are higher than background a one-sided upper tolerance limit was calculated.

As provided in Gibbons, the tolerance limit is calculated from:

TL = mean + K * (std. deviation)

Where K is a factor determined from statistical tables based on the number of samples in the background data set and the desired confidence and coverage goals. Consistent with Gibbons, 1994, a 95% confidence level with 95% coverage was used. Based on a background data set of 9 samples and these goals, and using Table 4.2 of Gibbons (attached), K was set at 3.032 for all background data sets. The resultant upper tolerance limits are listed in Table G-1.

TABLE G-1 - BACKGROUND SAMPLE STATISTICS - INTRACOASTAL WATERWAY SEDIMENT

Compound	Number of Background Samples	Site-Specific Background Values (mg/kg)		
		Mean	Std. Dev.	Upper Tolerance Limit(1)
Aluminum	9	12,213	6,892	33,110
Antimony	9	4.02	2.83	12.6
Arsenic	9	5.81	3.11	15.2
Barium	9	210	48	354
Beryllium	9	0.766	0.403	1.99
Boron	9	27.6	12.8	66.5
Chromium	9	12.8	6.5	32.6
Cobalt	9	6.70	3.17	16.3
Copper	9	8.14	5.2	23.8
Lead	9	9.58	3.6	20.5
Lithium	9	21.4	14.4	65.1
Manganese	9	331	89	601
Mercury	9	0.018	0.013	0.0576
Molybdenum	9	0.24	0.07	0.446
Nickel	9	14.91	8.11	39.5
Strontium	9	59.2	22.1	126
Titanium	9	31.8	10.5	63.6
Vanadium	9	20.2	9.1	47.9
Zinc	9	36.04	13.68	77.5

Note:
(1) One-side upper tolerance limit for 95% confidence and 95% coverage for a background data set of 9 samples.

Attachment G-1

Excerpted Pages from Gibbons, 1994

STATISTICAL METHODS FOR GROUNDWATER MONITORING

Robert D. Gibbons
University of Illinois at Chicago

A WILEY-INTERSCIENCE PUBLICATION
JOHN WILEY & SONS, INC.
New York • Chichester • Brisbane • Toronto • Singapore

077032

allowable, the costly verification stage would not be required. This two-stage procedure is quite similar to the prediction limit approach described by Davis and McNichols (1987).

4.2 NORMAL TOLERANCE LIMITS

Assume that we have available estimates $\bar{x}$ and s of the mean and standard deviation based on n background observations with degrees of freedom $f = n - 1$ from a normal distribution. We require the factor K from the two-sided interval

$$\bar{x} \pm Ks \tag{4.1}$$

which leads to the statement, "At least a proportion P of the normal population is between $\bar{x} - Ks$ and $\bar{x} + Ks$ with confidence $1 - \alpha$." Wald and Wolfowitz (1946) showed that K can be approximated by

$$K \sim ru \tag{4.2}$$

where r is a function of n and P and is determined from the normal distribution

$$\frac{1}{\sqrt{2\pi}} \int_{(1/\sqrt{n})-r}^{(1/\sqrt{n})+r} \exp\left(\frac{-x^2}{2}\right) dx = P \tag{4.3}$$

and u is a function of f and α and is defined as the $(1 - \alpha)100\%$ of the chi-square distribution as

$$u = \sqrt{\frac{f}{\chi^2_{\alpha, f}}} \tag{4.4}$$

By selecting a coverage probability P, (4.3) may be solved for r (since n is known), and by selecting a confidence level P, (4.4) may be solved for u (since $f = n - 1$ is known). Two-sided values of K are provided in Table 4.1 for $n = 4$ to ∞, 95% confidence and 95% and 99% coverage.

For one-sided tolerance limits $\bar{x} + Ks$, we require the factor K which leads to the statement, "At least a proportion P of the normal population is less than $\bar{x} + Ks$ with confidence $1 - \alpha$." Owen (1962) determines K by

$$\Pr\left\{\left(\text{noncentral } t \text{ with } \delta = z\sqrt{n}\right) \le K\sqrt{n}\right\} = 1 - \alpha \tag{4.5}$$

where δ is the noncentrality parameter of the noncentral t-distribution with

TABLE 4.1 Factors (K) for Constructing Two-Sided Normal Tolerance Limits ($\bar{x} \pm Ks$) for 95% Confidence and 95% and 99% Coverage

n	95% Coverage	99% Coverage
4	6.370	8.299
5	5.079	6.634
6	4.414	5.775
7	4.007	5.248
8	3.732	4.891
9	3.532	4.631
10	3.379	4.433
11	3.259	4.277
12	3.169	4.150
13	3.081	4.044
14	3.012	3.955
15	2.954	3.878
16	2.903	3.812
17	2.858	3.754
18	2.819	3.702
19	2.784	3.656
20	2.752	3.615
21	2.723	3.577
22	2.697	3.543
23	2.673	3.512
24	2.651	3.483
25	2.631	3.457
30	2.549	3.350
35	2.490	3.272
40	2.445	3.212
50	2.379	3.126
60	2.333	3.066
80	2.272	2.986
100	2.233	2.934
500	2.070	2.721
∞	1.960	2.576

$f = n - 1$ degrees of freedom, and z is defined by

$$\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{z} \exp\left(\frac{-x^2}{2}\right) dx = P \qquad (4.6)$$

One-sided values of K are provided in Table 4.2 for $n = 4$ to ∞, 95% confidence and 95% and 99% coverage.

To illustrate the differences between tolerance and prediction limits, Figure 4.1 displays power curves for a 95% confidence normal prediction

TABLE 4.2 Factors (K) for Constructing One-Sided Normal Tolerance Limits ($\bar{x} + Ks$) for 95% Confidence and 95% and 99% Coverage

n	95% Coverage	99% Coverage
4	5.144	7.042
5	4.210	5.749
6	3.711	5.065
7	3.401	4.643
8	3.188	4.355
9	3.032	4.144
10	2.911	3.981
11	2.815	3.852
12	2.736	3.747
13	2.670	3.659
14	2.614	3.585
15	2.566	3.520
16	2.523	3.463
17	2.486	3.414
18	2.453	3.370
19	2.423	3.331
20	2.396	3.295
21	2.371	3.262
22	2.350	3.233
23	2.329	3.206
24	2.309	3.181
25	2.292	3.158
30	2.220	3.064
35	2.166	2.994
40	2.126	2.941
50	2.065	2.863
60	2.022	2.807
80	1.965	2.733
100	1.927	2.684
500	1.763	2.475
∞	1.645	2.326

limit for the next $k = 100$ measurements based on a previous sample of $n = 20$, and a corresponding 95% confidence 95% coverage normal tolerance limit and 95% confidence 99% coverage normal tolerance limit. Inspection of Figure 4.1 reveals that the probability of failing at least one of the 100 comparisons by chance alone is much greater for the tolerance limits which have expected failure rates of 1% and 5%, respectively, versus the prediction limit that is designed to include 100% of the next 100 measurements with 95% confidence. Use of these two alternative limits for groundwater detection monitoring is anything but a "matter of personal preference."

Attachment G-2

Background Intracoastal Waterway Sediment Data
PRO UCL Output Pages

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	J:\1352 - Gulfco RI\risk\data queries oct 07\EPC tables with onehalf DL\SWE data - JUST BACKGROUN		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

Result or 1/2 SDL (aluminum)

General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		**Log-transformed Statistics**	
Minimum	4730	Minimum of Log Data	8.462
Maximum	21800	Maximum of Log Data	9.99
Mean	12213	Mean of log Data	9.255
Median	10800	SD of log Data	0.604
SD	6892		
Coefficient of Variation	0.564		
Skewness	0.403		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.877	Shapiro Wilk Test Statistic	0.903
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	16486	95% H-UCL	21311
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	23251
95% Adjusted-CLT UCL	16322	97.5% Chebyshev (MVUE) UCL	28003
95% Modified-t UCL	16537	99% Chebyshev (MVUE) UCL	37338
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.326	**Data appear Normal at 5% Significance Level**	
Theta Star	5252		
nu star	41.86		
Approximate Chi Square Value (.05)	28.03	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0231	95% CLT UCL	15992
Adjusted Chi Square Value	25.67	95% Jackknife UCL	16486
		95% Standard Bootstrap UCL	15868
Anderson-Darling Test Statistic	0.414	95% Bootstrap-t UCL	16987
Anderson-Darling 5% Critical Value	0.726	95% Hall's Bootstrap UCL	15294
Kolmogorov-Smirnov Test Statistic	0.176	95% Percentile Bootstrap UCL	15962
Kolmogorov-Smirnov 5% Critical Value	0.281	95% BCA Bootstrap UCL	16143
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	22228
		97.5% Chebyshev(Mean, Sd) UCL	26561
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	35073
95% Approximate Gamma UCL	18240		
95% Adjusted Gamma UCL	19920		

Potential UCL to Use		Use 95% Student's-t UCL	16486
Result or 1/2 SDL (antimony)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	1.68	Minimum of Log Data	0.519
Maximum	7.33	Maximum of Log Data	1.992
Mean	4.023	Mean of log Data	1.251
Median	2.83	SD of log Data	0.568
SD	2.215		
Coefficient of Variation	0.55		
Skewness	0.488		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.866	Shapiro Wilk Test Statistic	0.897
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	5.396	95% H-UCL	6.669
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	7.407
95% Adjusted-CLT UCL	5.366	97.5% Chebyshev (MVUE) UCL	8.87
95% Modified-t UCL	5.416	99% Chebyshev (MVUE) UCL	11.74
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.544	Data appear Normal at 5% Significance Level	
Theta Star	1.581		
nu star	45.79		
Approximate Chi Square Value (.05)	31.27	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	5.238
Adjusted Chi Square Value	28.76	95% Jackknife UCL	5.396
		95% Standard Bootstrap UCL	5.162
Anderson-Darling Test Statistic	0.505	95% Bootstrap-t UCL	5.647
Anderson-Darling 5% Critical Value	0.726	95% Hall's Bootstrap UCL	5.056
Kolmogorov-Smirnov Test Statistic	0.233	95% Percentile Bootstrap UCL	5.179
Kolmogorov-Smirnov 5% Critical Value	0.281	95% BCA Bootstrap UCL	5.317
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	7.241
		97.5% Chebyshev(Mean, Sd) UCL	8.634
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	11.37
95% Approximate Gamma UCL	5.892		
95% Adjusted Gamma UCL	6.407		
Potential UCL to Use		Use 95% Student's-t UCL	5.396
Result or 1/2 SDL (arsenic)			

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	General Statistics		
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	2.36	Minimum of Log Data	0.859
Maximum	9.62	Maximum of Log Data	2.264
Mean	5.813	Mean of log Data	1.623
Median	4.63	SD of log Data	0.566
SD	3.107		
Coefficient of Variation	0.534		
Skewness	0.351		
	Relevant UCL Statistics		
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.834	Shapiro Wilk Test Statistic	0.878
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	7.739	95% H-UCL	9.637
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	10.71
95% Adjusted-CLT UCL	7.646	97.5% Chebyshev (MVUE) UCL	12.83
95% Modified-t UCL	7.759	99% Chebyshev (MVUE) UCL	16.97
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.603	Data appear Normal at 5% Significance Level	
Theta Star	2.233		
nu star	46.86		
Approximate Chi Square Value (.05)	32.15	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	7.517
Adjusted Chi Square Value	29.61	95% Jackknife UCL	7.739
		95% Standard Bootstrap UCL	7.434
Anderson-Darling Test Statistic	0.558	95% Bootstrap-t UCL	8.076
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	7.145
Kolmogorov-Smirnov Test Statistic	0.223	95% Percentile Bootstrap UCL	7.417
Kolmogorov-Smirnov 5% Critical Value	0.281	95% BCA Bootstrap UCL	7.482
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	10.33
		97.5% Chebyshev(Mean, Sd) UCL	12.28
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	16.12
95% Approximate Gamma UCL	8.473		
95% Adjusted Gamma UCL	9.202		
Potential UCL to Use		Use 95% Student's-t UCL	7.739
Result or 1/2 SDL (barium)			
	General Statistics		
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	111	Minimum of Log Data	4.71

Maximum	280	Maximum of Log Data	5.635
Mean	209.7	Mean of log Data	5.318
Median	201	SD of log Data	0.263
SD	47.73		
Coefficient of Variation	0.228		
Skewness	-0.775		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.93	Shapiro Wilk Test Statistic	0.849
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	239.2	95% H-UCL	253.9
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	291.1
95% Adjusted-CLT UCL	231.4	97.5% Chebyshev (MVUE) UCL	326
95% Modified-t UCL	238.6	99% Chebyshev (MVUE) UCL	394.7
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	12.22	Data appear Normal at 5% Significance Level	
Theta Star	17.15		
nu star	220		
Approximate Chi Square Value (.05)	186.7	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	235.8
Adjusted Chi Square Value	180.2	95% Jackknife UCL	239.2
		95% Standard Bootstrap UCL	234
Anderson-Darling Test Statistic	0.517	95% Bootstrap-t UCL	235.6
Anderson-Darling 5% Critical Value	0.721	95% Hall's Bootstrap UCL	234.9
Kolmogorov-Smirnov Test Statistic	0.25	95% Percentile Bootstrap UCL	233.1
Kolmogorov-Smirnov 5% Critical Value	0.279	95% BCA Bootstrap UCL	229.7
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	279
		97.5% Chebyshev(Mean, Sd) UCL	309
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	368
95% Approximate Gamma UCL	247.1		
95% Adjusted Gamma UCL	256		
Potential UCL to Use		Use 95% Student's-t UCL	239.2
Result or 1/2 SDL (beryllium)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	0.32	Minimum of Log Data	-1.139
Maximum	1.32	Maximum of Log Data	0.278
Mean	0.766	Mean of log Data	-0.403
Median	0.69	SD of log Data	0.566
SD	0.403		
Coefficient of Variation	0.527		

Skewness	0.315		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.882	Shapiro Wilk Test Statistic	0.898
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1.016	95% H-UCL	1.27
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1.412
95% Adjusted-CLT UCL	1.002	97.5% Chebyshev (MVUE) UCL	1.69
95% Modified-t UCL	1.018	99% Chebyshev (MVUE) UCL	2.237
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.633	Data appear Normal at 5% Significance Level	
Theta Star	0.291		
nu star	47.4		
Approximate Chi Square Value (.05)	32.6	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	0.987
Adjusted Chi Square Value	30.03	95% Jackknife UCL	1.016
		95% Standard Bootstrap UCL	0.979
Anderson-Darling Test Statistic	0.424	95% Bootstrap-t UCL	1.059
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	0.948
Kolmogorov-Smirnov Test Statistic	0.18	95% Percentile Bootstrap UCL	0.973
Kolmogorov-Smirnov 5% Critical Value	0.281	95% BCA Bootstrap UCL	0.982
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.351
		97.5% Chebyshev(Mean, Sd) UCL	1.605
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.103
95% Approximate Gamma UCL	1.113		
95% Adjusted Gamma UCL	1.208		
Potential UCL to Use		Use 95% Student's-t UCL	1.016
Result or 1/2 SDL (boron)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	13.3	Minimum of Log Data	2.588
Maximum	47.9	Maximum of Log Data	3.869
Mean	27.64	Mean of log Data	3.222
Median	26	SD of log Data	0.472
SD	12.82		
Coefficient of Variation	0.464		
Skewness	0.532		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.911	Shapiro Wilk Test Statistic	0.938

Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	35.59	95% H-UCL	40.83
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	46.85
95% Adjusted-CLT UCL	35.48	97.5% Chebyshev (MVUE) UCL	55.15
95% Modified-t UCL	35.71	99% Chebyshev (MVUE) UCL	71.47
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.598	Data appear Normal at 5% Significance Level	
Theta Star	7.684		
nu star	64.76		
Approximate Chi Square Value (.05)	47.24	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	34.67
Adjusted Chi Square Value	44.1	95% Jackknife UCL	35.59
		95% Standard Bootstrap UCL	34.26
Anderson-Darling Test Statistic	0.301	95% Bootstrap-t UCL	37.11
Anderson-Darling 5% Critical Value	0.723	95% Hall's Bootstrap UCL	35.23
Kolmogorov-Smirnov Test Statistic	0.159	95% Percentile Bootstrap UCL	34.48
Kolmogorov-Smirnov 5% Critical Value	0.28	95% BCA Bootstrap UCL	34.57
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	46.26
		97.5% Chebyshev(Mean, Sd) UCL	54.32
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	70.15
95% Approximate Gamma UCL	37.89		
95% Adjusted Gamma UCL	40.59		
Potential UCL to Use		Use 95% Student's-t UCL	35.59
Result or 1/2 SDL (chromium)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	5.81	Minimum of Log Data	1.76
Maximum	22.5	Maximum of Log Data	3.114
Mean	12.81	Mean of log Data	2.43
Median	11.1	SD of log Data	0.527
SD	6.512		
Coefficient of Variation	0.508		
Skewness	0.444		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.89	Shapiro Wilk Test Statistic	0.911
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	16.85	95% H-UCL	20.21

95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	22.82
95% Adjusted-CLT UCL	16.73	97.5% Chebyshev (MVUE) UCL	27.14
95% Modified-t UCL	16.9	99% Chebyshev (MVUE) UCL	35.62
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.941	Data appear Normal at 5% Significance Level	
Theta Star	4.356		
nu star	52.95		
Approximate Chi Square Value (.05)	37.23	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	16.38
Adjusted Chi Square Value	34.47	95% Jackknife UCL	16.85
		95% Standard Bootstrap UCL	16.16
Anderson-Darling Test Statistic	0.391	95% Bootstrap-t UCL	17.1
Anderson-Darling 5% Critical Value	0.724	95% Hall's Bootstrap UCL	16
Kolmogorov-Smirnov Test Statistic	0.167	95% Percentile Bootstrap UCL	16.15
Kolmogorov-Smirnov 5% Critical Value	0.28	95% BCA Bootstrap UCL	16.4
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	22.28
		97.5% Chebyshev(Mean, Sd) UCL	26.37
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	34.41
95% Approximate Gamma UCL	18.22		
95% Adjusted Gamma UCL	19.68		
Potential UCL to Use		Use 95% Student's-t UCL	16.85

Result or 1/2 SDL (cobalt)

General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	3.32	Minimum of Log Data	1.2
Maximum	11.8	Maximum of Log Data	2.468
Mean	6.698	Mean of log Data	1.8
Median	5.92	SD of log Data	0.481
SD	3.165		
Coefficient of Variation	0.473		
Skewness	0.508		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.904	Shapiro Wilk Test Statistic	0.92
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	8.66	95% H-UCL	9.999
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	11.45
95% Adjusted-CLT UCL	8.624	97.5% Chebyshev (MVUE) UCL	13.5
95% Modified-t UCL	8.69	99% Chebyshev (MVUE) UCL	17.53
Gamma Distribution Test		Data Distribution	

k star (bias corrected)	3.458	Data appear Normal at 5% Significance Level	
Theta Star	1.937		
nu star	62.24		
Approximate Chi Square Value (.05)	45.09	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0231	95% CLT UCL	8.433
Adjusted Chi Square Value	42.03	95% Jackknife UCL	8.66
		95% Standard Bootstrap UCL	8.302
Anderson-Darling Test Statistic	0.361	95% Bootstrap-t UCL	9.077
Anderson-Darling 5% Critical Value	0.723	95% Hall's Bootstrap UCL	8.39
Kolmogorov-Smirnov Test Statistic	0.171	95% Percentile Bootstrap UCL	8.386
Kolmogorov-Smirnov 5% Critical Value	0.28	95% BCA Bootstrap UCL	8.506
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	11.3
		97.5% Chebyshev(Mean, Sd) UCL	13.29
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	17.2
95% Approximate Gamma UCL	9.245		
95% Adjusted Gamma UCL	9.918		
Potential UCL to Use		Use 95% Student's-t UCL	8.66

Result or 1/2 SDL (copper)

General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		**Log-transformed Statistics**	
Minimum	2.68	Minimum of Log Data	0.986
Maximum	16.8	Maximum of Log Data	2.821
Mean	8.138	Mean of log Data	1.902
Median	6.87	SD of log Data	0.676
SD	5.165		
Coefficient of Variation	0.635		
Skewness	0.626		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.903	Shapiro Wilk Test Statistic	0.934
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	11.34	95% H-UCL	15.71
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	16.4
95% Adjusted-CLT UCL	11.35	97.5% Chebyshev (MVUE) UCL	19.95
95% Modified-t UCL	11.4	99% Chebyshev (MVUE) UCL	26.94
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.895	**Data appear Normal at 5% Significance Level**	
Theta Star	4.294		
nu star	34.11		
Approximate Chi Square Value (.05)	21.76	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0231	95% CLT UCL	10.97

Adjusted Chi Square Value	19.7	95% Jackknife UCL	11.34
		95% Standard Bootstrap UCL	10.82
Anderson-Darling Test Statistic	0.31	95% Bootstrap-t UCL	12.21
Anderson-Darling 5% Critical Value	0.728	95% Hall's Bootstrap UCL	11.03
Kolmogorov-Smirnov Test Statistic	0.177	95% Percentile Bootstrap UCL	11
Kolmogorov-Smirnov 5% Critical Value	0.282	95% BCA Bootstrap UCL	11.25
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	15.64
		97.5% Chebyshev(Mean, Sd) UCL	18.89
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	25.27
95% Approximate Gamma UCL	12.76		
95% Adjusted Gamma UCL	14.09		
Potential UCL to Use		Use 95% Student's-t UCL	11.34
Result or 1/2 SDL (lead)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		**Log-transformed Statistics**	
Minimum	5.34	Minimum of Log Data	1.675
Maximum	14.5	Maximum of Log Data	2.674
Mean	9.587	Mean of log Data	2.194
Median	9.2	SD of log Data	0.393
SD	3.603		
Coefficient of Variation	0.376		
Skewness	0.161		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.898	Shapiro Wilk Test Statistic	0.901
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	11.82	95% H-UCL	13.05
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15.14
95% Adjusted-CLT UCL	11.63	97.5% Chebyshev (MVUE) UCL	17.53
95% Modified-t UCL	11.83	99% Chebyshev (MVUE) UCL	22.23
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	5.179	**Data appear Normal at 5% Significance Level**	
Theta Star	1.851		
nu star	93.21		
Approximate Chi Square Value (.05)	71.95	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0231	95% CLT UCL	11.56
Adjusted Chi Square Value	68.02	95% Jackknife UCL	11.82
		95% Standard Bootstrap UCL	11.42
Anderson-Darling Test Statistic	0.417	95% Bootstrap-t UCL	11.81
Anderson-Darling 5% Critical Value	0.722	95% Hall's Bootstrap UCL	11.21
Kolmogorov-Smirnov Test Statistic	0.182	95% Percentile Bootstrap UCL	11.47

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Kolmogorov-Smirnov 5% Critical Value	0.28	95% BCA Bootstrap UCL	11.5
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	14.82
		97.5% Chebyshev(Mean, Sd) UCL	17.09
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	21.54
95% Approximate Gamma UCL	12.42		
95% Adjusted Gamma UCL	13.14		
Potential UCL to Use		Use 95% Student's-t UCL	11.82

Result or 1/2 SDL (lithium)

General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	7.29	Minimum of Log Data	1.987
Maximum	44.6	Maximum of Log Data	3.798
Mean	21.4	Mean of log Data	2.852
Median	17.1	SD of log Data	0.697
SD	14.41		
Coefficient of Variation	0.673		
Skewness	0.724		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk Test Statistic	0.916
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	30.33	95% H-UCL	42.41
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	43.59
95% Adjusted-CLT UCL	30.54	97.5% Chebyshev (MVUE) UCL	53.19
95% Modified-t UCL	30.52	99% Chebyshev (MVUE) UCL	72.04
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.757	Data appear Normal at 5% Significance Level	
Theta Star	12.18		
nu star	31.63		
Approximate Chi Square Value (.05)	19.78	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	29.3
Adjusted Chi Square Value	17.83	95% Jackknife UCL	30.33
		95% Standard Bootstrap UCL	28.8
Anderson-Darling Test Statistic	0.391	95% Bootstrap-t UCL	33.46
Anderson-Darling 5% Critical Value	0.728	95% Hall's Bootstrap UCL	30.42
Kolmogorov-Smirnov Test Statistic	0.18	95% Percentile Bootstrap UCL	29.2
Kolmogorov-Smirnov 5% Critical Value	0.282	95% BCA Bootstrap UCL	29.71
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	42.33
		97.5% Chebyshev(Mean, Sd) UCL	51.39
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	69.18
95% Approximate Gamma UCL	34.22		

95% Adjusted Gamma UCL	37.96		
Potential UCL to Use		Use 95% Student's-t UCL	30.33
Result or 1/2 SDL (manganese)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		**Log-transformed Statistics**	
Minimum	212	Minimum of Log Data	5.357
Maximum	442	Maximum of Log Data	6.091
Mean	330.7	Mean of log Data	5.767
Median	321	SD of log Data	0.284
SD	88.99		
Coefficient of Variation	0.269		
Skewness	-0.147		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.909	Shapiro Wilk Test Statistic	0.899
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	385.8	95% H-UCL	406.9
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	468.4
95% Adjusted-CLT UCL	377.9	97.5% Chebyshev (MVUE) UCL	527.8
95% Modified-t UCL	385.6	99% Chebyshev (MVUE) UCL	644.6
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	9.817	Data appear Normal at 5% Significance Level	
Theta Star	33.68		
nu star	176.7		
Approximate Chi Square Value (.05)	147	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0231	95% CLT UCL	379.5
Adjusted Chi Square Value	141.2	95% Jackknife UCL	385.8
		95% Standard Bootstrap UCL	377.3
Anderson-Darling Test Statistic	0.414	95% Bootstrap-t UCL	388.1
Anderson-Darling 5% Critical Value	0.721	95% Hall's Bootstrap UCL	372.4
Kolmogorov-Smirnov Test Statistic	0.197	95% Percentile Bootstrap UCL	377.9
Kolmogorov-Smirnov 5% Critical Value	0.279	95% BCA Bootstrap UCL	377.8
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	460
		97.5% Chebyshev(Mean, Sd) UCL	515.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	625.8
95% Approximate Gamma UCL	397.6		
95% Adjusted Gamma UCL	413.7		
Potential UCL to Use		Use 95% Student's-t UCL	385.8

Result or 1/2 SDL (mercury)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	8
Raw Statistics		Log-transformed Statistics	
Minimum	0.0065	Minimum of Log Data	-5.036
Maximum	0.05	Maximum of Log Data	-2.996
Mean	0.0176	Mean of log Data	-4.227
Median	0.016	SD of log Data	0.613
SD	0.0132		
Coefficient of Variation	0.753		
Skewness	2.163		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.752	Shapiro Wilk Test Statistic	0.946
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0258	95% H-UCL	0.0302
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0328
95% Adjusted-CLT UCL	0.0282	97.5% Chebyshev (MVUE) UCL	0.0396
95% Modified-t UCL	0.0263	99% Chebyshev (MVUE) UCL	0.0529
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.962	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.0089		
nu star	35.32		
Approximate Chi Square Value (.05)	22.73	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	0.0248
Adjusted Chi Square Value	20.62	95% Jackknife UCL	0.0258
		95% Standard Bootstrap UCL	0.0245
Anderson-Darling Test Statistic	0.431	95% Bootstrap-t UCL	0.0345
Anderson-Darling 5% Critical Value	0.727	95% Hall's Bootstrap UCL	0.0568
Kolmogorov-Smirnov Test Statistic	0.184	95% Percentile Bootstrap UCL	0.0253
Kolmogorov-Smirnov 5% Critical Value	0.282	95% BCA Bootstrap UCL	0.0281
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0368
		97.5% Chebyshev(Mean, Sd) UCL	0.0452
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.0615
95% Approximate Gamma UCL	0.0273		
95% Adjusted Gamma UCL	0.0301		
Potential UCL to Use		Use 95% Approximate Gamma UCL	0.0273
Result or 1/2 SDL (molybdenum)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9

Raw Statistics		Log-transformed Statistics	
Minimum	0.16	Minimum of Log Data	-1.833
Maximum	0.35	Maximum of Log Data	-1.05
Mean	0.241	Mean of log Data	-1.458
Median	0.24	SD of log Data	0.282
SD	0.0675		
Coefficient of Variation	0.28		
Skewness	0.35		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.936	Shapiro Wilk Test Statistic	0.942
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.283	95% H-UCL	0.296
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.34
95% Adjusted-CLT UCL	0.281	97.5% Chebyshev (MVUE) UCL	0.383
95% Modified-t UCL	0.283	99% Chebyshev (MVUE) UCL	0.468
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	9.681	Data appear Normal at 5% Significance Level	
Theta Star	0.0249		
nu star	174.3		
Approximate Chi Square Value (.05)	144.7	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	0.278
Adjusted Chi Square Value	139	95% Jackknife UCL	0.283
		95% Standard Bootstrap UCL	0.276
Anderson-Darling Test Statistic	0.283	95% Bootstrap-t UCL	0.287
Anderson-Darling 5% Critical Value	0.721	95% Hall's Bootstrap UCL	0.277
Kolmogorov-Smirnov Test Statistic	0.167	95% Percentile Bootstrap UCL	0.279
Kolmogorov-Smirnov 5% Critical Value	0.279	95% BCA Bootstrap UCL	0.279
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.339
		97.5% Chebyshev(Mean, Sd) UCL	0.382
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.465
95% Approximate Gamma UCL	0.29		
95% Adjusted Gamma UCL	0.302		
Potential UCL to Use		Use 95% Student's-t UCL	0.283

Result or 1/2 SDL (nickel)

General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	6.31	Minimum of Log Data	1.842
Maximum	27.3	Maximum of Log Data	3.307
Mean	14.91	Mean of log Data	2.562
Median	13	SD of log Data	0.571

SD	8.111		
Coefficient of Variation	0.544		
Skewness	0.452		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.892	Shapiro Wilk Test Statistic	0.909
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	19.94	95% H-UCL	24.87
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	27.58
95% Adjusted-CLT UCL	19.79	97.5% Chebyshev (MVUE) UCL	33.04
95% Modified-t UCL	20.01	99% Chebyshev (MVUE) UCL	43.78
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.55	Data appear Normal at 5% Significance Level	
Theta Star	5.847		
nu star	45.91		
Approximate Chi Square Value (.05)	31.36	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	19.36
Adjusted Chi Square Value	28.85	95% Jackknife UCL	19.94
		95% Standard Bootstrap UCL	19.07
Anderson-Darling Test Statistic	0.395	95% Bootstrap-t UCL	20.74
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	19.07
Kolmogorov-Smirnov Test Statistic	0.172	95% Percentile Bootstrap UCL	19.29
Kolmogorov-Smirnov 5% Critical Value	0.281	95% BCA Bootstrap UCL	19.38
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	26.7
		97.5% Chebyshev(Mean, Sd) UCL	31.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	41.81
95% Approximate Gamma UCL	21.83		
95% Adjusted Gamma UCL	23.73		
Potential UCL to Use		Use 95% Student's-t UCL	19.94

Result or 1/2 SDL (strontium)

General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	34.8	Minimum of Log Data	3.55
Maximum	87.4	Maximum of Log Data	4.47
Mean	59.17	Mean of log Data	4.015
Median	59.3	SD of log Data	0.388
SD	22.06		
Coefficient of Variation	0.373		
Skewness	0.141		
Relevant UCL Statistics			

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.854	Shapiro Wilk Test Statistic	0.849
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	72.84	95% H-UCL	80.08
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	92.89
95% Adjusted-CLT UCL	71.63	97.5% Chebyshev (MVUE) UCL	107.5
95% Modified-t UCL	72.9	99% Chebyshev (MVUE) UCL	136.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	5.29	Data appear Normal at 5% Significance Level	
Theta Star	11.18		
nu star	95.22		
Approximate Chi Square Value (.05)	73.71	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	71.26
Adjusted Chi Square Value	69.73	95% Jackknife UCL	72.84
		95% Standard Bootstrap UCL	70.38
Anderson-Darling Test Statistic	0.641	95% Bootstrap-t UCL	73.34
Anderson-Darling 5% Critical Value	0.722	95% Hall's Bootstrap UCL	68.76
Kolmogorov-Smirnov Test Statistic	0.247	95% Percentile Bootstrap UCL	70.71
Kolmogorov-Smirnov 5% Critical Value	0.28	95% BCA Bootstrap UCL	70.68
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	91.22
		97.5% Chebyshev(Mean, Sd) UCL	105.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	132.3
95% Approximate Gamma UCL	76.43		
95% Adjusted Gamma UCL	80.79		
Potential UCL to Use		Use 95% Student's-t UCL	72.84

Result or 1/2 SDL (titanium)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	21.1	Minimum of Log Data	3.049
Maximum	54.5	Maximum of Log Data	3.998
Mean	31.79	Mean of log Data	3.417
Median	28.6	SD of log Data	0.297
SD	10.49		
Coefficient of Variation	0.33		
Skewness	1.471		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.859	Shapiro Wilk Test Statistic	0.932
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	38.29	95% H-UCL	39.38
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	45.43
95% Adjusted-CLT UCL	39.37	97.5% Chebyshev (MVUE) UCL	51.38
95% Modified-t UCL	38.58	99% Chebyshev (MVUE) UCL	63.05
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	8.159	Data appear Normal at 5% Significance Level	
Theta Star	3.896		
nu star	146.9		
Approximate Chi Square Value (.05)	119.9	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	37.54
Adjusted Chi Square Value	114.7	95% Jackknife UCL	38.29
		95% Standard Bootstrap UCL	37.24
Anderson-Darling Test Statistic	0.42	95% Bootstrap-t UCL	45.1
Anderson-Darling 5% Critical Value	0.722	95% Hall's Bootstrap UCL	71.11
Kolmogorov-Smirnov Test Statistic	0.239	95% Percentile Bootstrap UCL	37.36
Kolmogorov-Smirnov 5% Critical Value	0.279	95% BCA Bootstrap UCL	38.54
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	47.03
		97.5% Chebyshev(Mean, Sd) UCL	53.62
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	66.58
95% Approximate Gamma UCL	38.95		
95% Adjusted Gamma UCL	40.7		
Potential UCL to Use		Use 95% Student's-t UCL	38.29
Result or 1/2 SDL (vanadium)			
General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	10.2	Minimum of Log Data	2.322
Maximum	34.2	Maximum of Log Data	3.532
Mean	20.21	Mean of log Data	2.913
Median	19.1	SD of log Data	0.461
SD	9.135		
Coefficient of Variation	0.452		
Skewness	0.468		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9	Shapiro Wilk Test Statistic	0.919
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	25.87	95% H-UCL	29.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	33.92
95% Adjusted-CLT UCL	25.73	97.5% Chebyshev (MVUE) UCL	39.86
95% Modified-t UCL	25.95	99% Chebyshev (MVUE) UCL	51.51

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.758	Data appear Normal at 5% Significance Level	
Theta Star	5.378		
nu star	67.64		
Approximate Chi Square Value (.05)	49.71	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	25.22
Adjusted Chi Square Value	46.49	95% Jackknife UCL	25.87
		95% Standard Bootstrap UCL	25.06
Anderson-Darling Test Statistic	0.366	95% Bootstrap-t UCL	27.18
Anderson-Darling 5% Critical Value	0.723	95% Hall's Bootstrap UCL	25.34
Kolmogorov-Smirnov Test Statistic	0.183	95% Percentile Bootstrap UCL	24.86
Kolmogorov-Smirnov 5% Critical Value	0.28	95% BCA Bootstrap UCL	25.47
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	33.48
		97.5% Chebyshev(Mean, Sd) UCL	39.23
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	50.51
95% Approximate Gamma UCL	27.5		
95% Adjusted Gamma UCL	29.41		
Potential UCL to Use		Use 95% Student's-t UCL	25.87

Result or 1/2 SDL (zinc)

General Statistics			
Number of Valid Samples	9	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	19.3	Minimum of Log Data	2.96
Maximum	54.1	Maximum of Log Data	3.991
Mean	36.04	Mean of log Data	3.515
Median	34.1	SD of log Data	0.404
SD	13.68		
Coefficient of Variation	0.379		
Skewness	0.0735		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.901	Shapiro Wilk Test Statistic	0.897
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	44.52	95% H-UCL	49.64
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	57.54
95% Adjusted-CLT UCL	43.66	97.5% Chebyshev (MVUE) UCL	66.8
95% Modified-t UCL	44.54	99% Chebyshev (MVUE) UCL	84.99
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	4.975	Data appear Normal at 5% Significance Level	
Theta Star	7.246		
nu star	89.54		

Approximate Chi Square Value (.05)	68.73	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	43.54
Adjusted Chi Square Value	64.89	95% Jackknife UCL	44.52
		95% Standard Bootstrap UCL	43.07
Anderson-Darling Test Statistic	0.426	95% Bootstrap-t UCL	44.13
Anderson-Darling 5% Critical Value	0.722	95% Hall's Bootstrap UCL	42.14
Kolmogorov-Smirnov Test Statistic	0.197	95% Percentile Bootstrap UCL	43.13
Kolmogorov-Smirnov 5% Critical Value	0.28	95% BCA Bootstrap UCL	43.06
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	55.91
		97.5% Chebyshev(Mean, Sd) UCL	64.51
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	81.4
95% Approximate Gamma UCL	46.96		
95% Adjusted Gamma UCL	49.74		
Potential UCL to Use		Use 95% Student's-t UCL	44.52

APPENDIX H

SOIL BACKGROUND CONCENTRATION TOLERANCE LIMIT CALCULATIONS

APPENDIX H

SOIL BACKGROUND CONCENTRATION TOLERANCE LIMIT CALCULATIONS

Tolerance limits were calculated for background metals analytes using the procedure described in Gibbons, 1994, and used for background Intracoastal Waterway sediments in Appendix G. A step-by-step discussion of these calculations is provided below.

Step 1 - Calculate the Background Mean and Standard Deviation

These parameters were calculated for each background metal using EPA's *PRO UCL* statistical software package (EPA, 2007). These parameters are summarized in Table H-1.

Step 2- Calculate Tolerance Limit

Since the purpose of the tolerance limit is to identify metals concentrations that are higher than background a one-sided upper tolerance limit was calculated.

As provided in Gibbons, the tolerance limit is calculated from:

TL = mean + K * (std. deviation)

Where K is a factor determined from statistical tables based on the number of samples in the background data set and the desired confidence and coverage goals. Consistent with Gibbons, 1994, a 95% confidence level with 95% coverage was used. Based on a background data set of 10 samples and these goals, and using Table 4.2 of Gibbons (see Appendix G), K was set at 2.911 for all background data sets, except for barium and zinc. The resultant upper tolerance limits are listed in Table H-1.

In the case of barium, inspection of the background data set (see Table H-2) indicates one value (1,130 mg/kg) significantly higher than the other nine values (mean of 244 mg/kg), and likely indicative of anthropogenic sources. Although EPA, 2002 does provide for consideration of anthropogenic sources not related to the site of interest when making background comparisons, for conservative purposes and based on discussions with EPA regarding the background zinc data (see below), this anomalously high barium concentration was removed from the background data set prior to calculating the barium tolerance limit. The background barium mean and standard deviation based on the remaining nine background values are listed in Table H-1. These values along with a K factor based on nine samples were used to calculate the barium tolerance limit in Table H-1.

Similarly for zinc, two values in the background data set (Table H-3) are significantly higher than the other eight values, although none of the zinc values were identified as outliers by a statistical test (Dixon's outlier test) using *PRO UCL*. Notwithstanding these findings and per discussions with EPA regarding the spatial distribution of the zinc concentrations within the background area, the two highest zinc concentrations were removed from the background data set prior to calculating the zinc tolerance limit. The background zinc mean and standard deviation based on the remaining eight background values are listed in Table H-1. These values along with a K factor based on eight samples were used to calculate the zinc tolerance limit in Table H-1.

TABLE H-1 - BACKGROUND SAMPLE STATISTICS - SOIL

Compound	Site-Specific Background Values (mg/kg)		
	Mean	Std. Dev.	Upper Tolerance Limit(1)
Arsenic	3.44	1.79	8.66
Barium(2)	244	72	462
Chromium	15.2	3.0	24.0
Copper	12.1	4.0	23.6
Lead	13.4	1.5	17.9
Lithium	21.1	5.2	36.2
Manganese	377	94	650
Mercury	0.021	0.005	0.035
Molybdenum	0.52	0.07	0.74
Zinc (3)	76.3	64.0	280

Note:
(1) One-side upper tolerance limit for 95% confidence and 95% coverage.
(2) Barium parameters calculated using data set with highest concentration removed.
(3) Zinc parameters calculated using data set with two highest concentrations removed.

TABLE H-2 - BARIUM CONCENTRATIONS IN BACKGROUND SOIL SAMPLES

Sample Location	Concentration (mg/kg)
BSS-1	322
BSS-2	361
BSS-3	237
BSS-4	281
BSS-5	150
BSS-6	1130
BSS-7	281
BSS-8	215
BSS-9	177
BSS-10	177

TABLE H-3 - ZINC CONCENTRATIONS IN BACKGROUND SOIL SAMPLES

Sample Location	Concentration (mg/kg)
BSS-1	969
BSS-2	81.2
BSS-3	77
BSS-4	40.9
BSS-5	36.6
BSS-6	890J
BSS-7	227J
BSS-8	74J
BSS-9	37.1J
BSS-10	36.8J

Note:
Data qualifier: J = estimated value.

Attachment H-1

Background Soil Data
PRO UCL Output Pages

General UCL Statistics for Full Data Sets

User Selected Options	
From File	J:\1352 - Gulfco RI\risk\eco\Tables for Revisited SLERA\background soil table.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Result or 1/2 SDL (antimony)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	10
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.125	Minimum of Log Data	-2.079
Maximum	2.19	Maximum of Log Data	0.784
Mean	0.953	Mean of log Data	-0.711
Median	0.815	SD of log Data	1.345
SD	0.878		
Coefficient of Variation	0.921		
Skewness	0.157		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.775	Shapiro Wilk Test Statistic	0.726
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1.462	95% H-UCL	6.827
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3.117
95% Adjusted-CLT UCL	1.424	97.5% Chebyshev (MVUE) UCL	4.01
95% Modified-t UCL	1.464	99% Chebyshev (MVUE) UCL	5.765
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.685	Data do not follow a Discernable Distribution (0.05)	
Theta Star	1.39		
nu star	13.71		
Approximate Chi Square Value (.05)	6.373	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	1.41
Adjusted Chi Square Value	5.527	95% Jackknife UCL	1.462
		95% Standard Bootstrap UCL	1.381
Anderson-Darling Test Statistic	1.346	95% Bootstrap-t UCL	1.452
Anderson-Darling 5% Critical Value	0.752	95% Hall's Bootstrap UCL	1.306
Kolmogorov-Smirnov Test Statistic	0.329	95% Percentile Bootstrap UCL	1.394
Kolmogorov-Smirnov 5% Critical Value	0.275	95% BCA Bootstrap UCL	1.416
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2.163
		97.5% Chebyshev(Mean, Sd) UCL	2.687
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3.715
95% Approximate Gamma UCL	2.05		
95% Adjusted Gamma UCL	2.364		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	3.715
Recommended UCL exceeds the maximum observation			

Result or 1/2 SDL (arsenic)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	10
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.24	Minimum of Log Data	-1.427
Maximum	5.9	Maximum of Log Data	1.775
Mean	3.438	Mean of log Data	0.985
Median	3.625	SD of log Data	0.947
SD	1.792		
Coefficient of Variation	0.521		
Skewness	-0.35		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.946	Shapiro Wilk Test Statistic	0.749
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	4.477	95% H-UCL	10.79
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	9.349
95% Adjusted-CLT UCL	4.303	97.5% Chebyshev (MVUE) UCL	11.68
95% Modified-t UCL	4.466	99% Chebyshev (MVUE) UCL	16.27
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.572	Data appear Normal at 5% Significance Level	
Theta Star	2.187		
nu star	31.44		

Approximate Chi Square Value (.05)	19.63	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	4.37
Adjusted Chi Square Value	18.03	95% Jackknife UCL	4.477
		95% Standard Bootstrap UCL	4.299
Anderson-Darling Test Statistic	0.699	95% Bootstrap-t UCL	4.371
Anderson-Darling 5% Critical Value	0.735	95% Hall's Bootstrap UCL	4.292
Kolmogorov-Smirnov Test Statistic	0.293	95% Percentile Bootstrap UCL	4.299
Kolmogorov-Smirnov 5% Critical Value	0.27	95% BCA Bootstrap UCL	4.27
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	5.908
		97.5% Chebyshev(Mean, Sd) UCL	6.976
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	9.075
95% Approximate Gamma UCL	5.507		
95% Adjusted Gamma UCL	5.997		
Potential UCL to Use		Use 95% Student's-t UCL	4.477

Result or 1/2 SDL (barium)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	8
Raw Statistics		Log-transformed Statistics	
Minimum	150	Minimum of Log Data	5.011
Maximum	1130	Maximum of Log Data	7.03
Mean	333.1	Mean of log Data	5.617
Median	259	SD of log Data	0.571
SD	288.1		
Coefficient of Variation	0.865		
Skewness	2.844		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.59	Shapiro Wilk Test Statistic	0.83
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	500.1	95% H-UCL	504
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	573.9
95% Adjusted-CLT UCL	570.5	97.5% Chebyshev (MVUE) UCL	684.7
95% Modified-t UCL	513.7	99% Chebyshev (MVUE) UCL	902.2
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.005	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	166.1		
nu star	40.11		
Approximate Chi Square Value (.05)	26.6	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	482.9
Adjusted Chi Square Value	24.7	95% Jackknife UCL	500.1
		95% Standard Bootstrap UCL	476.3
Anderson-Darling Test Statistic	1.01	95% Bootstrap-t UCL	877.8
Anderson-Darling 5% Critical Value	0.733	95% Hall's Bootstrap UCL	1100
Kolmogorov-Smirnov Test Statistic	0.268	95% Percentile Bootstrap UCL	505.4
Kolmogorov-Smirnov 5% Critical Value	0.269	95% BCA Bootstrap UCL	601.4
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	730.2
		97.5% Chebyshev(Mean, Sd) UCL	902
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1239
95% Approximate Gamma UCL	502.3		
95% Adjusted Gamma UCL	540.9		
Potential UCL to Use		Use 95% Approximate Gamma UCL	502.3

Result or 1/2 SDL (benzo(a)anthracene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	10
Raw Statistics		Log-transformed Statistics	
Minimum	0.00323	Minimum of Log Data	-5.735
Maximum	0.082	Maximum of Log Data	-2.501
Mean	0.0116	Mean of log Data	-5.267
Median	0.00381	SD of log Data	0.979
SD	0.0247		
Coefficient of Variation	2.125		
Skewness	3.16		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.383	Shapiro Wilk Test Statistic	0.478
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.026	95% H-UCL	0.0226

95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0189
95% Adjusted-CLT UCL	0.0328	97.5% Chebyshev (MVUE) UCL	0.0236
95% Modified-t UCL	0.0273	99% Chebyshev (MVUE) UCL	0.033
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.583	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.02		
nu star	11.66		
Approximate Chi Square Value (.05)	5.004	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.0245
Adjusted Chi Square Value	4.271	95% Jackknife UCL	0.026
		95% Standard Bootstrap UCL	0.0238
Anderson-Darling Test Statistic	2.903	95% Bootstrap-t UCL	0.543
Anderson-Darling 5% Critical Value	0.758	95% Hall's Bootstrap UCL	0.258
Kolmogorov-Smirnov Test Statistic	0.513	95% Percentile Bootstrap UCL	0.0272
Kolmogorov-Smirnov 5% Critical Value	0.276	95% BCA Bootstrap UCL	0.0351
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0457
		97.5% Chebyshev(Mean, Sd) UCL	0.0605
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.0894
95% Approximate Gamma UCL	0.0271		
95% Adjusted Gamma UCL	0.0318		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	0.0457

Result or 1/2 SDL (benzo(a)pyrene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	7
Raw Statistics		Log-transformed Statistics	
Minimum	0.00434	Minimum of Log Data	-5.44
Maximum	0.076	Maximum of Log Data	-2.577
Mean	0.0122	Mean of log Data	-5.008
Median	0.005	SD of log Data	0.863
SD	0.0224		
Coefficient of Variation	1.833		
Skewness	3.157		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.391	Shapiro Wilk Test Statistic	0.495
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0252	95% H-UCL	0.0219
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0207
95% Adjusted-CLT UCL	0.0314	97.5% Chebyshev (MVUE) UCL	0.0257
95% Modified-t UCL	0.0264	99% Chebyshev (MVUE) UCL	0.0354
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.739	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0165		
nu star	14.78		
Approximate Chi Square Value (.05)	7.109	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.0239
Adjusted Chi Square Value	6.207	95% Jackknife UCL	0.0252
		95% Standard Bootstrap UCL	0.0233
Anderson-Darling Test Statistic	2.773	95% Bootstrap-t UCL	0.307
Anderson-Darling 5% Critical Value	0.75	95% Hall's Bootstrap UCL	0.171
Kolmogorov-Smirnov Test Statistic	0.505	95% Percentile Bootstrap UCL	0.0263
Kolmogorov-Smirnov 5% Critical Value	0.274	95% BCA Bootstrap UCL	0.0334
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0431
		97.5% Chebyshev(Mean, Sd) UCL	0.0565
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.0828
95% Approximate Gamma UCL	0.0254		
95% Adjusted Gamma UCL	0.0291		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	0.0431

Result or 1/2 SDL (benzo(b)fluoranthene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	10
Raw Statistics		Log-transformed Statistics	
Minimum	0.00349	Minimum of Log Data	-5.658
Maximum	0.057	Maximum of Log Data	-2.865
Mean	0.00941	Mean of log Data	-5.234
Median	0.00411	SD of log Data	0.84
SD	0.0167		
Coefficient of Variation	1.777		
Skewness	3.157		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.393	Shapiro Wilk Test Statistic	0.497
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0191	95% H-UCL	0.0166
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.016
95% Adjusted-CLT UCL	0.0238	97.5% Chebyshev (MVUE) UCL	0.0198
95% Modified-t UCL	0.02	99% Chebyshev (MVUE) UCL	0.0272
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.777	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0121		
nu star	15.53		
Approximate Chi Square Value (.05)	7.632	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.0181
Adjusted Chi Square Value	6.692	95% Jackknife UCL	0.0191
		95% Standard Bootstrap UCL	0.0179
Anderson-Darling Test Statistic	2.757	95% Bootstrap-t UCL	0.231
Anderson-Darling 5% Critical Value	0.748	95% Hall's Bootstrap UCL	0.116
Kolmogorov-Smirnov Test Statistic	0.496	95% Percentile Bootstrap UCL	0.02
Kolmogorov-Smirnov 5% Critical Value	0.274	95% BCA Bootstrap UCL	0.0252
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0325
		97.5% Chebyshev(Mean, Sd) UCL	0.0424
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.062
95% Approximate Gamma UCL	0.0192		
95% Adjusted Gamma UCL	0.0218		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	0.0325

Result or 1/2 SDL (benzo(g,h,i)perylene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	0.015	Minimum of Log Data	-4.2
Maximum	0.083	Maximum of Log Data	-2.489
Mean	0.0241	Mean of log Data	-3.896
Median	0.0173	SD of log Data	0.508
SD	0.0208		
Coefficient of Variation	0.866		
Skewness	3.104		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.458	Shapiro Wilk Test Statistic	0.581
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0361	95% H-UCL	0.0337
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0391
95% Adjusted-CLT UCL	0.0418	97.5% Chebyshev (MVUE) UCL	0.0461
95% Modified-t UCL	0.0372	99% Chebyshev (MVUE) UCL	0.0599
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.254	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0107		
nu star	45.09		
Approximate Chi Square Value (.05)	30.68	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.0349
Adjusted Chi Square Value	28.63	95% Jackknife UCL	0.0361
		95% Standard Bootstrap UCL	0.034
Anderson-Darling Test Statistic	2.124	95% Bootstrap-t UCL	0.111
Anderson-Darling 5% Critical Value	0.732	95% Hall's Bootstrap UCL	0.0864
Kolmogorov-Smirnov Test Statistic	0.417	95% Percentile Bootstrap UCL	0.0365
Kolmogorov-Smirnov 5% Critical Value	0.268	95% BCA Bootstrap UCL	0.038
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0527
		97.5% Chebyshev(Mean, Sd) UCL	0.0652
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.0895
95% Approximate Gamma UCL	0.0353		
95% Adjusted Gamma UCL	0.0379		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	0.0527

Result or 1/2 SDL (benzo(k)fluoranthene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	7
Raw Statistics		Log-transformed Statistics	

Minimum	0.00493	Minimum of Log Data	-5.313
Maximum	0.106	Maximum of Log Data	-2.244
Mean	0.0158	Mean of log Data	-4.861
Median	0.00575	SD of log Data	0.927
SD	0.0317		
Coefficient of Variation	2		
Skewness	3.16		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.386	Shapiro Wilk Test Statistic	0.483
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0342	95% H-UCL	0.0296
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0263
95% Adjusted-CLT UCL	0.043	97.5% Chebyshev (MVUE) UCL	0.0328
95% Modified-t UCL	0.0359	99% Chebyshev (MVUE) UCL	0.0455
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.644	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0246		
nu star	12.88		
Approximate Chi Square Value (.05)	5.815	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.0323
Adjusted Chi Square Value	5.014	95% Jackknife UCL	0.0342
		95% Standard Bootstrap UCL	0.0311
Anderson-Darling Test Statistic	2.864	95% Bootstrap-t UCL	0.608
Anderson-Darling 5% Critical Value	0.754	95% Hall's Bootstrap UCL	0.269
Kolmogorov-Smirnov Test Statistic	0.505	95% Percentile Bootstrap UCL	0.0358
Kolmogorov-Smirnov 5% Critical Value	0.275	95% BCA Bootstrap UCL	0.046
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0595
		97.5% Chebyshev(Mean, Sd) UCL	0.0784
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.116
95% Approximate Gamma UCL	0.0351		
95% Adjusted Gamma UCL	0.0407		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	0.0595

Result or 1/2 SDL (cadmium)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	8
Raw Statistics		Log-transformed Statistics	
Minimum	0.0075	Minimum of Log Data	-4.893
Maximum	0.11	Maximum of Log Data	-2.207
Mean	0.0311	Mean of log Data	-4.091
Median	0.0095	SD of log Data	1.081
SD	0.0398		
Coefficient of Variation	1.283		
Skewness	1.571		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.641	Shapiro Wilk Test Statistic	0.713
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0541	95% H-UCL	0.0974
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.071
95% Adjusted-CLT UCL	0.0585	97.5% Chebyshev (MVUE) UCL	0.0898
95% Modified-t UCL	0.0552	99% Chebyshev (MVUE) UCL	0.127
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.725	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0428		
nu star	14.5		
Approximate Chi Square Value (.05)	6.912	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.0518
Adjusted Chi Square Value	6.025	95% Jackknife UCL	0.0541
		95% Standard Bootstrap UCL	0.0507
Anderson-Darling Test Statistic	1.584	95% Bootstrap-t UCL	0.105
Anderson-Darling 5% Critical Value	0.75	95% Hall's Bootstrap UCL	0.0699
Kolmogorov-Smirnov Test Statistic	0.411	95% Percentile Bootstrap UCL	0.0515
Kolmogorov-Smirnov 5% Critical Value	0.274	95% BCA Bootstrap UCL	0.0581
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.086
		97.5% Chebyshev(Mean, Sd) UCL	0.11
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.156
95% Approximate Gamma UCL	0.0651		
95% Adjusted Gamma UCL	0.0747		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	0.156

Recommended UCL exceeds the maximum observation

Result or 1/2 SDL (carbazole)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	9
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.00376	Minimum of Log Data	-5.583
Maximum	0.011	Maximum of Log Data	-4.51
Mean	0.00512	Mean of log Data	-5.328
Median	0.00443	SD of log Data	0.312
SD	0.00214		
Coefficient of Variation	0.418		
Skewness	2.781		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.608	Shapiro Wilk Test Statistic	0.731
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.00636	95% H-UCL	0.00627
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.00727
95% Adjusted-CLT UCL	0.00687	97.5% Chebyshev (MVUE) UCL	0.00822
95% Modified-t UCL	0.00646	99% Chebyshev (MVUE) UCL	0.0101
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	6.758	Data do not follow a Discernable Distribution (0.05)	
Theta Star	7.57E-04		
nu star	135.2		
Approximate Chi Square Value (.05)	109.3	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.00623
Adjusted Chi Square Value	105.3	95% Jackknife UCL	0.00636
		95% Standard Bootstrap UCL	0.0062
Anderson-Darling Test Statistic	1.249	95% Bootstrap-t UCL	0.00912
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	0.0106
Kolmogorov-Smirnov Test Statistic	0.286	95% Percentile Bootstrap UCL	0.00636
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL	0.00679
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.00807
		97.5% Chebyshev(Mean, Sd) UCL	0.00934
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.0119
95% Approximate Gamma UCL	0.00633		
95% Adjusted Gamma UCL	0.00657		
Potential UCL to Use		Use 95% Student's-t UCL	0.00636
		or 95% Modified-t UCL	0.00646

Result or 1/2 SDL (chromium)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	9
Raw Statistics		**Log-transformed Statistics**	
Minimum	10.7	Minimum of Log Data	2.37
Maximum	20.1	Maximum of Log Data	3.001
Mean	15.2	Mean of log Data	2.703
Median	14.15	SD of log Data	0.199
SD	3.02		
Coefficient of Variation	0.199		
Skewness	0.27		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.936	Shapiro Wilk Test Statistic	0.945
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	16.95	95% H-UCL	17.26
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	19.39
95% Adjusted-CLT UCL	16.86	97.5% Chebyshev (MVUE) UCL	21.21
95% Modified-t UCL	16.96	99% Chebyshev (MVUE) UCL	24.77
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	19.81	Data appear Normal at 5% Significance Level	
Theta Star	0.767		
nu star	396.2		
Approximate Chi Square Value (.05)	351.1	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0267	95% CLT UCL	16.77
Adjusted Chi Square Value	343.7	95% Jackknife UCL	16.95
		95% Standard Bootstrap UCL	16.7
Anderson-Darling Test Statistic	0.388	95% Bootstrap-t UCL	17.01

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Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	16.75
Kolmogorov-Smirnov Test Statistic	0.205	95% Percentile Bootstrap UCL	16.71
Kolmogorov-Smirnov 5% Critical Value	0.266	95% BCA Bootstrap UCL	16.74
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	19.36
		97.5% Chebyshev(Mean, Sd) UCL	21.16
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	24.7
95% Approximate Gamma UCL	17.15		
95% Adjusted Gamma UCL	17.52		
Potential UCL to Use		Use 95% Student's-t UCL	16.95

Result or 1/2 SDL (chrysene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	6
Raw Statistics		Log-transformed Statistics	
Minimum	0.006	Minimum of Log Data	-5.116
Maximum	0.083	Maximum of Log Data	-2.489
Mean	0.0145	Mean of log Data	-4.742
Median	0.00675	SD of log Data	0.8
SD	0.0241		
Coefficient of Variation	1.668		
Skewness	3.156		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.395	Shapiro Wilk Test Statistic	0.493
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0284	95% H-UCL	0.0247
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0247
95% Adjusted-CLT UCL	0.0351	97.5% Chebyshev (MVUE) UCL	0.0305
95% Modified-t UCL	0.0297	99% Chebyshev (MVUE) UCL	0.0417
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.856	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0169		
nu star	17.12		
Approximate Chi Square Value (.05)	8.758	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.027
Adjusted Chi Square Value	7.74	95% Jackknife UCL	0.0284
		95% Standard Bootstrap UCL	0.0264
Anderson-Darling Test Statistic	2.737	95% Bootstrap-t UCL	0.307
Anderson-Darling 5% Critical Value	0.746	95% Hall's Bootstrap UCL	0.154
Kolmogorov-Smirnov Test Statistic	0.496	95% Percentile Bootstrap UCL	0.0296
Kolmogorov-Smirnov 5% Critical Value	0.273	95% BCA Bootstrap UCL	0.0372
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0477
		97.5% Chebyshev(Mean, Sd) UCL	0.062
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.0903
95% Approximate Gamma UCL	0.0282		
95% Adjusted Gamma UCL	0.032		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	0.0477

Result or 1/2 SDL (copper)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	10
Raw Statistics		Log-transformed Statistics	
Minimum	7.68	Minimum of Log Data	2.039
Maximum	19.3	Maximum of Log Data	2.96
Mean	12.12	Mean of log Data	2.449
Median	10.8	SD of log Data	0.313
SD	3.955		
Coefficient of Variation	0.326		
Skewness	0.802		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.911	Shapiro Wilk Test Statistic	0.948
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	14.41	95% H-UCL	14.96
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	17.35
95% Adjusted-CLT UCL	14.51	97.5% Chebyshev (MVUE) UCL	19.63
95% Modified-t UCL	14.46	99% Chebyshev (MVUE) UCL	24.1
Gamma Distribution Test		Data Distribution	

k star (bias corrected)	7.922	Data appear Normal at 5% Significance Level	
Theta Star	1.529		
nu star	158.4		
Approximate Chi Square Value (.05)	130.3	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	14.17
Adjusted Chi Square Value	125.9	95% Jackknife UCL	14.41
		95% Standard Bootstrap UCL	14.08
Anderson-Darling Test Statistic	0.317	95% Bootstrap-t UCL	15.03
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	14.63
Kolmogorov-Smirnov Test Statistic	0.175	95% Percentile Bootstrap UCL	14.04
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL	14.54
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	17.57
		97.5% Chebyshev(Mean, Sd) UCL	19.93
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	24.56
95% Approximate Gamma UCL	14.73		
95% Adjusted Gamma UCL	15.25		
Potential UCL to Use		Use 95% Student's-t UCL	14.41

Result or 1/2 SDL (fluoranthene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	7
Raw Statistics		Log-transformed Statistics	
Minimum	0.00486	Minimum of Log Data	-5.328
Maximum	0.156	Maximum of Log Data	-1.858
Mean	0.0208	Mean of log Data	-4.834
Median	0.00575	SD of log Data	1.053
SD	0.0475		
Coefficient of Variation	2.286		
Skewness	3.161		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.38	Shapiro Wilk Test Statistic	0.477
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0483	95% H-UCL	0.0428
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0324
95% Adjusted-CLT UCL	0.0615	97.5% Chebyshev (MVUE) UCL	0.0409
95% Modified-t UCL	0.0508	99% Chebyshev (MVUE) UCL	0.0575
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.513	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0405		
nu star	10.26		
Approximate Chi Square Value (.05)	4.106	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.0455
Adjusted Chi Square Value	3.456	95% Jackknife UCL	0.0483
		95% Standard Bootstrap UCL	0.0443
Anderson-Darling Test Statistic	2.929	95% Bootstrap-t UCL	1.171
Anderson-Darling 5% Critical Value	0.766	95% Hall's Bootstrap UCL	0.527
Kolmogorov-Smirnov Test Statistic	0.515	95% Percentile Bootstrap UCL	0.0508
Kolmogorov-Smirnov 5% Critical Value	0.278	95% BCA Bootstrap UCL	0.0659
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0863
		97.5% Chebyshev(Mean, Sd) UCL	0.115
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.17
95% Approximate Gamma UCL	0.0519		
95% Adjusted Gamma UCL	0.0617		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	0.17
Recommended UCL exceeds the maximum observation			

Result or 1/2 SDL (indeno(1,2,3-cd)pyrene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	0.0125	Minimum of Log Data	-4.382
Maximum	0.417	Maximum of Log Data	-0.875
Mean	0.0551	Mean of log Data	-3.88
Median	0.0148	SD of log Data	1.063
SD	0.127		
Coefficient of Variation	2.308		
Skewness	3.161		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.379	Shapiro Wilk Test Statistic	0.47
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842

Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.129	95% H-UCL	0.114
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0853
95% Adjusted-CLT UCL	0.164	97.5% Chebyshev (MVUE) UCL	0.108
95% Modified-t UCL	0.136	99% Chebyshev (MVUE) UCL	0.152
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.505	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.109		
nu star	10.09		
Approximate Chi Square Value (.05)	4	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.121
Adjusted Chi Square Value	3.36	95% Jackknife UCL	0.129
		95% Standard Bootstrap UCL	0.119
Anderson-Darling Test Statistic	2.966	95% Bootstrap-t UCL	3.62
Anderson-Darling 5% Critical Value	0.767	95% Hall's Bootstrap UCL	1.642
Kolmogorov-Smirnov Test Statistic	0.523	95% Percentile Bootstrap UCL	0.135
Kolmogorov-Smirnov 5% Critical Value	0.278	95% BCA Bootstrap UCL	0.175
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.23
		97.5% Chebyshev(Mean, Sd) UCL	0.306
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.455
95% Approximate Gamma UCL	0.139		
95% Adjusted Gamma UCL	0.166		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	0.455
Recommended UCL exceeds the maximum observation			

Result or 1/2 SDL (lead)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	11	Minimum of Log Data	2.398
Maximum	15.2	Maximum of Log Data	2.721
Mean	13.43	Mean of log Data	2.591
Median	13.35	SD of log Data	0.118
SD	1.547		
Coefficient of Variation	0.115		
Skewness	-0.326		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.913	Shapiro Wilk Test Statistic	0.909
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	14.33	95% H-UCL	14.43
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15.62
95% Adjusted-CLT UCL	14.18	97.5% Chebyshev (MVUE) UCL	16.56
95% Modified-t UCL	14.32	99% Chebyshev (MVUE) UCL	18.42
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	57	Data appear Normal at 5% Significance Level	
Theta Star	0.236		
nu star	1140		
Approximate Chi Square Value (.05)	1063	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	14.23
Adjusted Chi Square Value	1050	95% Jackknife UCL	14.33
		95% Standard Bootstrap UCL	14.18
Anderson-Darling Test Statistic	0.379	95% Bootstrap-t UCL	14.21
Anderson-Darling 5% Critical Value	0.724	95% Hall's Bootstrap UCL	14.11
Kolmogorov-Smirnov Test Statistic	0.169	95% Percentile Bootstrap UCL	14.17
Kolmogorov-Smirnov 5% Critical Value	0.266	95% BCA Bootstrap UCL	14.15
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	15.56
		97.5% Chebyshev(Mean, Sd) UCL	16.49
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	18.3
95% Approximate Gamma UCL	14.41		
95% Adjusted Gamma UCL	14.59		
Potential UCL to Use		Use 95% Student's-t UCL	14.33

Result or 1/2 SDL (lithium)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	10
Raw Statistics		Log-transformed Statistics	
Minimum	14.4	Minimum of Log Data	2.667
Maximum	32.5	Maximum of Log Data	3.481
Mean	21.14	Mean of log Data	3.027

Median	19.9	SD of log Data	0.229
SD	5.166		
Coefficient of Variation	0.244		
Skewness	1.214		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.912	Shapiro Wilk Test Statistic	0.965
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	24.13	95% H-UCL	24.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	27.82
95% Adjusted-CLT UCL	24.5	97.5% Chebyshev (MVUE) UCL	30.72
95% Modified-t UCL	24.24	99% Chebyshev (MVUE) UCL	36.42
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	14.43	Data appear Normal at 5% Significance Level	
Theta Star	1.465		
nu star	288.6		
Approximate Chi Square Value (.05)	250.3	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	23.83
Adjusted Chi Square Value	244.1	95% Jackknife UCL	24.13
		95% Standard Bootstrap UCL	23.71
Anderson-Darling Test Statistic	0.311	95% Bootstrap-t UCL	26.29
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	40.64
Kolmogorov-Smirnov Test Statistic	0.2	95% Percentile Bootstrap UCL	23.86
Kolmogorov-Smirnov 5% Critical Value	0.266	95% BCA Bootstrap UCL	24.4
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	28.26
		97.5% Chebyshev(Mean, Sd) UCL	31.34
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	37.39
95% Approximate Gamma UCL	24.38		
95% Adjusted Gamma UCL	25		
Potential UCL to Use		Use 95% Student's-t UCL	24.13

Result or 1/2 SDL (manganese)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	9
Raw Statistics		Log-transformed Statistics	
Minimum	284	Minimum of Log Data	5.649
Maximum	551	Maximum of Log Data	6.312
Mean	377.4	Mean of log Data	5.909
Median	333	SD of log Data	0.227
SD	93.76		
Coefficient of Variation	0.248		
Skewness	1.28		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.796	Shapiro Wilk Test Statistic	0.843
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	431.8	95% H-UCL	436.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	495.4
95% Adjusted-CLT UCL	439	97.5% Chebyshev (MVUE) UCL	546.6
95% Modified-t UCL	433.8	99% Chebyshev (MVUE) UCL	647.4
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	14.38	Data appear Lognormal at 5% Significance Level	
Theta Star	26.25		
nu star	287.6		
Approximate Chi Square Value (.05)	249.3	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	426.2
Adjusted Chi Square Value	243.1	95% Jackknife UCL	431.8
		95% Standard Bootstrap UCL	422.7
Anderson-Darling Test Statistic	0.85	95% Bootstrap-t UCL	494.2
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	681.2
Kolmogorov-Smirnov Test Statistic	0.284	95% Percentile Bootstrap UCL	425.6
Kolmogorov-Smirnov 5% Critical Value	0.266	95% BCA Bootstrap UCL	436.6
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	506.6
		97.5% Chebyshev(Mean, Sd) UCL	562.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	672.4
95% Approximate Gamma UCL	435.3		
95% Adjusted Gamma UCL	446.4		
Potential UCL to Use		Use 95% Student's-t UCL	431.8
		or 95% Modified-t UCL	433.8
		or 95% H-UCL	436.5

Result or 1/2 SDL (mercury)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	8
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.015	Minimum of Log Data	-4.2
Maximum	0.03	Maximum of Log Data	-3.507
Mean	0.0213	Mean of log Data	-3.871
Median	0.0195	SD of log Data	0.217
SD	0.00479		
Coefficient of Variation	0.225		
Skewness	0.734		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.908	Shapiro Wilk Test Statistic	0.937
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0241	95% H-UCL	0.0245
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0277
95% Adjusted-CLT UCL	0.0242	97.5% Chebyshev (MVUE) UCL	0.0305
95% Modified-t UCL	0.0241	99% Chebyshev (MVUE) UCL	0.0359
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	16.3	Data appear Normal at 5% Significance Level	
Theta Star	0.00131		
nu star	326.1		
Approximate Chi Square Value (.05)	285.2	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.0238
Adjusted Chi Square Value	278.6	95% Jackknife UCL	0.0241
		95% Standard Bootstrap UCL	0.0236
Anderson-Darling Test Statistic	0.458	95% Bootstrap-t UCL	0.0246
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	0.024
Kolmogorov-Smirnov Test Statistic	0.2	95% Percentile Bootstrap UCL	0.0238
Kolmogorov-Smirnov 5% Critical Value	0.266	95% BCA Bootstrap UCL	0.0239
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0279
		97.5% Chebyshev(Mean, Sd) UCL	0.0308
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.0364
95% Approximate Gamma UCL	0.0243		
95% Adjusted Gamma UCL	0.0249		
Potential UCL to Use		Use 95% Student's-t UCL	0.0241

Result or 1/2 SDL (molybdenum)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	10
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.42	Minimum of Log Data	-0.868
Maximum	0.68	Maximum of Log Data	-0.386
Mean	0.522	Mean of log Data	-0.659
Median	0.505	SD of log Data	0.137
SD	0.0739		
Coefficient of Variation	0.142		
Skewness	0.94		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Test Statistic	0.974
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.565	95% H-UCL	0.568
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.621
95% Adjusted-CLT UCL	0.568	97.5% Chebyshev (MVUE) UCL	0.663
95% Modified-t UCL	0.566	99% Chebyshev (MVUE) UCL	0.747
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	40.85	Data appear Normal at 5% Significance Level	
Theta Star	0.0128		
nu star	817		
Approximate Chi Square Value (.05)	751.7	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.56
Adjusted Chi Square Value	740.8	95% Jackknife UCL	0.565
		95% Standard Bootstrap UCL	0.56
Anderson-Darling Test Statistic	0.217	95% Bootstrap-t UCL	0.579
Anderson-Darling 5% Critical Value	0.724	95% Hall's Bootstrap UCL	0.59
Kolmogorov-Smirnov Test Statistic	0.153	95% Percentile Bootstrap UCL	0.558
Kolmogorov-Smirnov 5% Critical Value	0.266	95% BCA Bootstrap UCL	0.561

Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.624
		97.5% Chebyshev(Mean, Sd) UCL	0.668
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.755
95% Approximate Gamma UCL	0.567		
95% Adjusted Gamma UCL	0.576		
Potential UCL to Use		Use 95% Student's-t UCL	0.565

Result or 1/2 SDL (phenanthrene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	10
Raw Statistics		Log-transformed Statistics	
Minimum	0.00286	Minimum of Log Data	-5.859
Maximum	0.137	Maximum of Log Data	-1.988
Mean	0.0167	Mean of log Data	-5.327
Median	0.00336	SD of log Data	1.179
SD	0.0423		
Coefficient of Variation	2.525		
Skewness	3.162		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.375	Shapiro Wilk Test Statistic	0.459
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0412	95% H-UCL	0.0383
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0239
95% Adjusted-CLT UCL	0.053	97.5% Chebyshev (MVUE) UCL	0.0304
95% Modified-t UCL	0.0435	99% Chebyshev (MVUE) UCL	0.0432
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.425	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0394		
nu star	8.497		
Approximate Chi Square Value (.05)	3.026	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.0387
Adjusted Chi Square Value	2.487	95% Jackknife UCL	0.0412
		95% Standard Bootstrap UCL	0.0378
Anderson-Darling Test Statistic	3.041	95% Bootstrap-t UCL	1.724
Anderson-Darling 5% Critical Value	0.776	95% Hall's Bootstrap UCL	0.748
Kolmogorov-Smirnov Test Statistic	0.53	95% Percentile Bootstrap UCL	0.0434
Kolmogorov-Smirnov 5% Critical Value	0.281	95% BCA Bootstrap UCL	0.0568
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.075
		97.5% Chebyshev(Mean, Sd) UCL	0.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.15
95% Approximate Gamma UCL	0.047		
95% Adjusted Gamma UCL	0.0572		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	0.15
Recommended UCL exceeds the maximum observation			

Result or 1/2 SDL (pyrene)

General Statistics			
Number of Valid Samples	10	Number of Unique Samples	7
Raw Statistics		Log-transformed Statistics	
Minimum	0.0085	Minimum of Log Data	-4.768
Maximum	0.127	Maximum of Log Data	-2.064
Mean	0.0218	Mean of log Data	-4.347
Median	0.01	SD of log Data	0.811
SD	0.037		
Coefficient of Variation	1.696		
Skewness	3.156		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.396	Shapiro Wilk Test Statistic	0.501
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0432	95% H-UCL	0.0376
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0373
95% Adjusted-CLT UCL	0.0535	97.5% Chebyshev (MVUE) UCL	0.046
95% Modified-t UCL	0.0452	99% Chebyshev (MVUE) UCL	0.063
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.834	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0262		